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ABSTRACT

This instructor's guide contains eight lesson plans for teaching soil conservation in accordance with the Missouri State Board of Education's Vocational Instructional Management System. To make the unit easier for teachers to use, the following materials are provided in the front of the unit: objectives and competencies for each lesson, a references and materials list, and a competency profile. Each of the eight lessons contains the following components: teaching procedures, information sheets, study questions, evaluation test with answers, references, and transparency masters. The lessons cover the following topics: benefits of conservation, land utilization, how soils are eroded, cropping and reduced tillage systems, no-till farming, erosion control structures, universal soil loss equation, and agency assistance. (KC)

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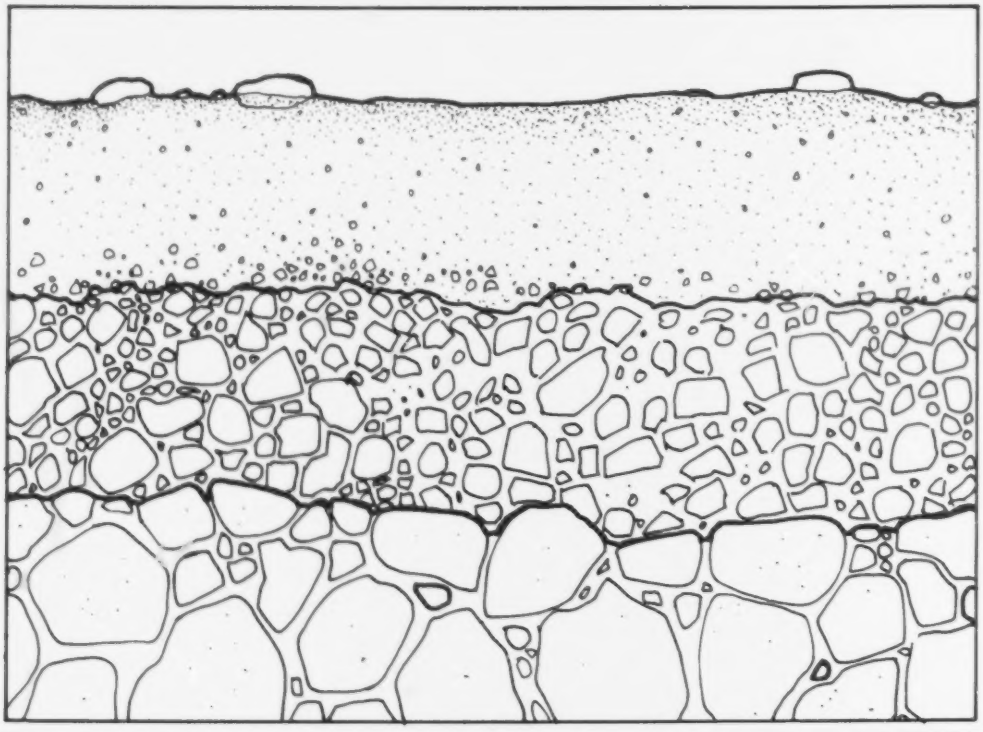
Soil Conservation Unit



for the Advanced Crop Production and Marketing Course

Instructor's Guide

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Department of Elementary and Secondary Education
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Instructor's Guide

SOIL CONSERVATION UNIT

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ACKNOWLEDGMENTS

The completion of this Soil Conservation unit represents the final addition to the four units for Advanced Crops: Corn and Sorghum, Soybeans, Forages and Soil Conservation. Its development was suggested by the MVATA Teaching Aids Committee.

Two posters, subject to limited availability, were packaged with the initial printing of this unit. "Are You a Conservation Farmer?" was furnished by the Soil Conservation Society of America, and "Land Resource Regions and Major Land Resource Areas of Missouri" was furnished by the Soil Conservation Service.

Special recognition for the unit's development is given to the Soil Conservation Advisory Committee members for providing their valuable time and suggestions. The committee consisted of Jim Bellis, Rolla Fraley, Doug Funk, Wendell Minson, Herman Peeper, Jim Robinson, H. Lane Thurman, Julie Tockman, David Twente, Bill Waddell, Jim Welker and Paul White.

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Special recognition is also due to Harley Schlichting, director, and his staff at the Instructional Materials Laboratory for the typing, editing and illustrating of this unit.

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FOREWORD

The Soil Conservation unit, a part of the Advanced Crops curriculum, builds on competencies gained in Agricultural Science I and II. An instructor's guide and student reference have been developed to facilitate the teaching/learning process.

The material consists of eight competency-based lessons: Benefits of Conservation, Land Utilization, How Soils Are Eroded, Cropping and Reduced Tillage Systems, No-Till Farming, Erosion Control Structures, Universal Soil Loss Equation and Agency Assistance.

During the summer of 1981, the Missouri State Board of Education formally adopted the concept of "Instructional Management Systems" (IMS) as a priority for the 1981-82 school year. Missouri Commissioner of Education Arthur L. Mallory has described the IMS concept as a practical way of "organizing for excellence" in education. To meet the demand for greater productivity and accountability, Dr. Frank Drake, Director of Vocational Education, applied the elements of IMS to form the "Vocational Instructional Management System" (VIMS). The VIMS process provides a framework to use in planning and organizing to assure excellence in Missouri's vocational educational system by focusing greater attention on the management of teaching and learning.

To aid vocational agriculture teachers in the implementation of VIMS, this guide incorporates the needed component parts to meet VIMS requirements. For ease of use, performance objectives and competencies have been included at the beginning of each unit, as well as being incorporated within each lesson. A competency profile has also been provided for convenient recordkeeping.

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SOIL CONSERVATION

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ADVANCED CROP PRODUCTION

UNIT: SOIL CONSERVATION

LESSONS

1. Benefits of Conservation
2. Land Utilization
3. How Soils Are Eroded
4. Cropping and Reduced Tillage Systems
5. No-Till Farming
6. Erosion Control Structures
7. Universal Soil Loss Equation
8. Agency Assistance

OBJECTIVES

1. The student will be able to explain why soil conservation is important to Missouri.*
2. The student will list the major land resource areas and their uses in relation to agriculture.
3. The student will be able to describe the erosion process.
4. The student will list cropping and tillage systems important in conserving soil.
5. The student will explain the fundamentals of no-till farming.
6. The student will identify the structures important in conserving soil.
7. The student will be able to estimate potential erosion in a field using the Universal Soil Loss Equation.
8. The student will be able to list the agencies that help farmers conserve soil.

*NOTE: Percent of accuracy should be set by instructors to reflect passing grade within their school system.

COMPETENCIES

1. Explain benefits of soil conservation to Missouri.

2. List major land resource areas and their uses.

3. Describe how soils are eroded.

4. List cropping and tillage systems which are important in conserving soil.

5. Explain the fundamentals of no-till farming.

6. Identify structures important for conserving soil.

7. Develop a resource management system for a field using the Universal Soil Loss Equation.

8. List agencies that help farmers conserve soil.

MOTIVATIONAL TECHNIQUE OR INTEREST APPROACH

1. Present visuals such as "The Living Landscape" videotape from the Missouri Department of Conservation to increase the students' awareness of the need for soil conservation.

2. Organize class or individual projects to coincide with school science fair entries.

3. Arrange field trips for any of the following activities: 1) taking soil samples, 2) observing eroded areas, 3) studying proper conservation practices, 4) visiting a local Soil Conservation Service or Agricultural Stabilization Service office.

EVALUATION

1. Give short, objective tests following each lesson and a more in-depth objective test at the conclusion of the unit.

2. Observe the changes in behavior as evidence of an improved ability of students to deal with problems in this unit using background acquired from earlier units.

3. Observe students' attempts to solve similar problems in their supervised occupational experience programs.

REFERENCES AND MATERIALS

1. Soil Conservation (Student Reference)

   Instructional Materials Laboratory
   10 Industrial Education Building
   University of Missouri-Columbia
   Columbia, MO 65211

2. Teacher references

   a) Beasley, R. P.; James M. Gregory; Thomas R. McCarty. Erosion and Sediment Pollution Control. Ames: Iowa State University, 1973. 2nd ed., 1984.

   b) Bosworth, Duane A., and Albert B. Foster. Approved Practices in Soil Conservation. Danville, Ill.: Interstate Printers and Publishers, Inc., 1982.

   c) Hudson, Norman. Soil Conservation. Ithaca, N.Y.: Cornell University Press, 1981.

   d) Fundamentals of No-Till Farming. Athens, Geo.: American Association for Vocational Instructional Materials, 1983.

   e) Soil Conservation Policies: An Assessment. Ankeny, Iowa: Soil Conservation Society of America, 1979.

   f) "Are You a Conservation Farmer?" Ankeny, Iowa: Soil Conservation Society of America, 1986.

   g) Instructional Materials Laboratory materials

      1) Field Crop Scouting Manual (AG-59-S). Urbana: Vocational Agriculture Service, University of Illinois, 1984.
      2) Evaluating Missouri Soils (AG-25-S). Columbia: UMC Extension Division, 1976.
      3) Soil Samples kit (AG-24-J)
      4) Soils and Dollars lesson plans (adult, AG-96-I)
      5) Soil Erosion slides/tape (AG-97-AV)
      6) Soil Profiles slides/tape (AG-99-AV)
      7) Soils Testing videotape (AG-991-AV)

   h) University of Missouri-Columbia Extension Division agricultural publications

      1) EC915: Evaluating Missouri Soils (1976)
      2) EC950: The Effects of Soil Erosion Upon Soil Productivity in Missouri Farm Fields (1985)
      3) 355: No-Tillage and Reduced Tillage: Costs and Returns (1986)

4) 1560: Estimating Soil Losses in Northern Missouri (1979)
5) 4080: No-Till Planting Systems (1983)
6) 4960: Cover Crops Management for No-Till Grain Crop Production (1986)
7) M117: Best Management Practices for Erosion and Sediment Control (1980)
8) MX101: Impact of Continued Soil Erosion (1978)
9) MX121: Conservation Tillage: Considerations for Missouri Farmers (1983)

i) Soil Conservation Service and Soil Conservation District materials

1) "Soil Conservation Systems for Missouri." Missouri Association of Soil and Water Conservation Districts, 1983.
2) "Topsoil--Our Vital Resource." Missouri Association of Soil and Water Conservation Districts, 1983.
3) "Teaching Soil and Water Conservation" (PA-341)
4) "Using Crop Residue to Help Control Wind and Water Erosion," 1986.
5) "Selecting a Terrace," 1984.
6) "Losing Ground: Iowa's Soil Erosion Menace and Efforts to Combat It." Des Moines: Soil Conservation Service, 1986.
7) 1982 National Resource Inventory (extensive statistical information)
8) Standards and Specifications for Conservation Practices (extensive reference material available at SCS state office, 555 Vandiver, Columbia, MO 65202)

Soil Conservation
MAJOR COMPETENCY PROFILE

Directions: Evaluate the student by checking the appropriate number or letter to indicate the degree of competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

Rating Scale:
- 3 **Mastered** - can work independently with no supervision
- 2 **Requires Supervision** - can perform job completely with limited supervision
- 1 **Not Mastered** - requires instruction and close supervision
- N **No Exposure** - no experience or knowledge in this area

3	2	1	N

Soil Conservation

1. Explain benefits of soil conservation to Missouri.
2. List major land resource areas and their uses.
3. Describe how soils are eroded.
4. List cropping and tillage systems which are important in conserving soil.
5. Explain the fundamentals of no-till farming.
6. Identify structures important for conserving soil.
7. Develop a resource management system for a field using the Universal Soil Loss Equation.
8. List agencies that help farmers conserve soil.

Soil Conservation

CLASS/SECTION: _____

STUDENTS:	Explain benefits of soil conservation to Missouri	List major land resource areas and their uses	Describe how soils are eroded	List cropping and tillage systems which are important in conserving soil	Explain the fundamentals of no-till farming	Identify structures important for conserving soil	Develop a resource management system for a field using the Universal Soil Loss Equation	List agencies that help farmers conserve soil		

UNIT - SOIL CONSERVATION

Lesson 1: Benefits of Conservation

Objective: The student will be able to explain why soil conservation is important to Missouri.

Study Questions

1. **What leaders and events were important to the soil conservation movement in the U.S. and Missouri?**

2. **What were some of the early American attitudes that led to farmland being allowed to "wash out"?**

3. **How does erosion affect topsoil?**

4. **What are the effects of soil erosion on crop production?**

5. **What other problems are caused by soil erosion?**

6. **How can conservation practices reduce soil erosion?**

References

1. Soil Conservation (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1987.

2. Transparency Masters

   a) TM 1.1: Sheet and Rill Erosion for Cropland
   b) TM 1.2: Erosion vs. Yield Study

3. Audiovisuals

   a) "Soil Profiles" slide set, IML.
   b) "The Living Landscape" videotape. Available on loan from MVRC or Missouri Department of Conservation Film Loan Library, P.O. Box 180, Jefferson City, MO 65102.

UNIT - SOIL CONSERVATION

Lesson 1: Benefits of Conservation

TEACHING PROCEDURES

A. Introduction

Introduce the unit.

B. Motivation

Show the Missouri Department of Conservation's "Living Landscape" videotape to motivate the students on the need for soil conservation.

C. Assignment

D. Supervised study

E. Discussion

1. Discuss with the students the awareness of soil erosion in U.S. history. Note the important figures in the fight against soil erosion and the important role that Missouri has played in soil conservation advancements. List noteworthy facts and figures on the board.

What leaders and events were important to the soil conservation movement in the U.S. and Missouri?

a) Some early Americans were conscious of the destructive force of erosion.
   1) George Washington, first president
   2) Thomas Jefferson, third president and agriculturalist
   3) Patrick Henry, patriot
b) Colonial settlers unwittingly exploited the land.
c) Missouri was an early leader in soil conservation.
   1) Sanborn Field, a National Historic Site on the University of Missouri-Columbia campus, was established in 1888 and is the oldest experiment field west of the Mississippi.
   2) Agricultural research was expanded in 1917 with the establishment of Station Field on the University of Missouri campus.
      (a) Set the pattern for other erosion studies throughout the nation
      (b) Studied effects of drought, fertility, rainfall, soil moisture and runoff
      (c) Soil loss measurements added later
d) The 1930s brought a national awakening to the serious problem of soil erosion.

1) The depressed economy and Dust Bowl effects stirred public interest in conservation.
2) Agriculture leaders and schools studied soil erosion at erosion experiment stations.
3) In 1935 Congress enacted the Soil Conservation Act, which established the Soil Conservation Service in the USDA.
   (a) Hugh Hammond Bennett, the first chief of the Soil Conservation Service, actively campaigned to shape the nation's thinking about soil erosion and has been called "the father of soil conservation."
   (b) Bennett enlisted the help of the Civilian Conservation Corps, an action supported by Pres. Franklin Roosevelt.
   (c) In 1937, Pres. Roosevelt wrote letters to all the state governors urging them to establish local soil and water conservation districts to work with the Soil Conservation Service; the first district was organized that year.
   (d) In 1938, legislation enacted the Soil and Water Conservation Districts at the national level to provide assistance to states through soil conservation districts.
   (e) Farmers and ranchers, working voluntarily with SCS employees, began changing farming practices and healing the Dust Bowl damage. During the next 20 years, conservation effects multiplied through government programs and local efforts.

2. Ask the students to describe attitudes that have led to severe soil erosion. Develop the notion of "farming out" a piece of cropland as it relates to soil erosion. Ask students if these same attitudes still exist today.

What were some of the early American attitudes that led to farmland being allowed to "wash out"?

a) Early Americans exploited natural resources.
   1) Fields were planted in same crop year after year.
   2) The attitude was that when the land wore out, new land could be brought into cultivation.
   3) Soil was considered an inexhaustible resource.
b) Some people still use farming practices that accelerate soil erosion.
   1) Because they are uninformed
   2) Because they are not aware of disastrous effects of soil erosion
   3) Because they are apprehensive about adopting conservation farming techniques
   4) Because they had always done it that way

3. Ask the students to define topsoil and to describe how it differs from subsoil. Base the discussion on topsoil in Missouri and the

area in particular. Emphasize the importance of topsoil and write these points on the board. Discuss the effects of erosion on topsoil. Emphasize that Missouri cannot continue to lose topsoil at the current rate and remain a productive agricultural state. Show TM 1.1 to illustrate the soil erosion problem on a national scale.

How does erosion affect topsoil?

a) Erosion is defined as the group of processes by which earthy or rock material is removed from any part of the earth's surface.
b) Topsoil is the thin, fertile layer of soil over much of the earth's surface.
    1) Produces our food and most of our clothing and shelter
    2) High in fertility, organic matter and water-holding capacity
    3) Very fragile; limited natural resource
c) The subsoil underlies the topsoil.
    1) Low in fertility, organic matter and water-holding capacity
    2) Cannot produce the crops, fibers and other materials needed to sustain life
d) When first settled, parts of Missouri had as much as 16-18 inches of topsoil.
    1) Because of soil erosion, up to one-half of the topsoil has been lost.
    2) Many fields are showing subsoil.
    3) Topsoil is lost because it is subjected to erosive forces during crop production.
        (a) Falling raindrops dislodge soil particles and splash them into solution.
        (b) Soil particles are carried off in running water.
        (c) Nutrients, organic matter, fertilizer, and pesticides are also washed away in the runoff.
e) Missouri ranks in the top five in U.S. soil erosion; each year 200 million tons erode from Missouri croplands--enough soil to fill a convoy of 10-ton dump trucks that would circle the world three times.

4. Ask students how topsoil erosion affects crop production; show the students TM 1.2. Note that at present rates of soil loss, many prime agricultural areas will lose their ability to produce economic crops in 100 years.

What are the effects of soil erosion on crop production?

a) Erosion removes valuable topsoil that produces crops.
b) As more topsoil is eroded, crop yields decrease accordingly.
    1) Professor C. M. Woodruff, University of Missouri, compared eroded and noneroded corn fields.
        (a) Both areas had the same fertilization.
        (b) Eroded areas produced 44 bushels less than noneroded areas.

2) Professor Robert Beasley, University of Missouri, surveyed the effects of erosion.
   (a) Soils with 12 inches of topsoil produced an average of 110 bushels of corn and 43 bushels of soybeans.
   (b) Severely eroded soils produced an average 83 bushels of corn and 24 bushels of soybeans.
3) Soil Conservation Service found that yields were greatly reduced in eroded fields.
   (a) Corn: 25% less from moderate erosion, 49% less from severe erosion
   (b) Soybeans: 9% less from moderate erosion, 28% less from severe erosion
   (c) Wheat: 12% less from moderate erosion, 41% less from severe erosion

5. Ask students to list problems associated with soil erosion. Write them on the board. Ask if any of the students have witnessed or experienced these problems. If so, have them relate their experiences to the class. Ask students about the contributing factors for sediment in Missouri waterways.

What other problems are caused by soil erosion?

a) Production characteristics of eroded soils
   1) Poor stands
   2) Increased production costs
   3) Decreased net income
b) Sediment moved to other areas
   1) Sediment fills road ditches, stream channels, ponds and lakes.
   2) Offsite damages are prevalent with flat, graded soils in the Bootheel.
      (a) Tail ditches leading to main ditches fill with soil.
      (b) If tail ditches are not dredged or cleaned, affected fields will have poor drainage.
   3) Increased water turbidity is harmful to fish and other aquatic organisms.
c) Soil particles separated from water for human consumption
d) Flooding potential increased when channels fill and lose water-carrying capacity

F. Other activities

1. Tour local farms to observe soil conservation practices in use and fields in need of conservation programs.

2. Show the IML slide set, "Soil Profiles."

3. Make a soil profile. Contact a soil scientist at SCS for assistance.

G. Conclusion

Concern over soil erosion has been noted throughout the history of the U.S. Early Americans 'washed out' the land by using farming practices that encouraged soil erosion. Valuable topsoil is still being lost today because of poor farming practices. Appropriate soil conservation practices can greatly reduce soil erosion.

H. Competency

Explain benefits of soil conservation to Missouri.

I. Answers to Evaluation

1. Two of the following: George Washington, Thomas Jefferson, Patrick Henry

2. Three of the following:
   a) Reduced crop yields
   b) Increased flooding potential
   c) Must clean water for domestic use
   d) Kills fish
   e) Wastes nutrients
   f) Increased production costs
   g) Decreased net income

3. 50%
4. Topsoil
5. Topsoil
6. Top five
7. Sanborn
8. Decreases

9. Many farmers have regarded and still do regard soil as an inexhaustible resource. They assumed that when fields were farmed out, they could move on to new fields.

10. Crop production will be greatly reduced and the ability to sustain life will diminish.

Name _____

UNIT - SOIL CONSERVATION

Date _____

Lesson 1: Benefits of Conservation

EVALUATION

1. Name two early American agriculturalists who recognized the necessity for soil conservation.

   a.

   b.

2. List three problems associated with soil erosion.

   a.

   b.

   c.

3. During the settlers' time, parts of Missouri had topsoil as deep as 16-18 inches, but erosion has reduced it by up to _____ %.

4. Which layer of soil is best for crop production? _____

5. Which layer of soil is high in fertility, high in organic matter, and has good water-holding capacities? _____

6. Missouri ranks in the _____ of all states in soil erosion.

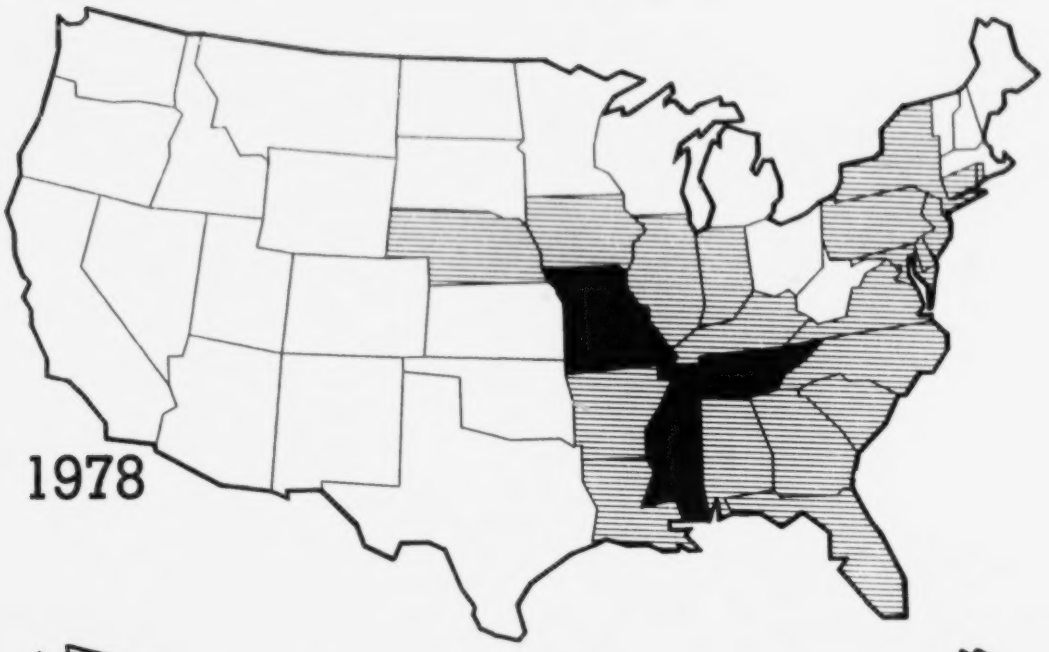
7. The oldest experiment field west of the Mississippi River is _____ Field in Columbia.

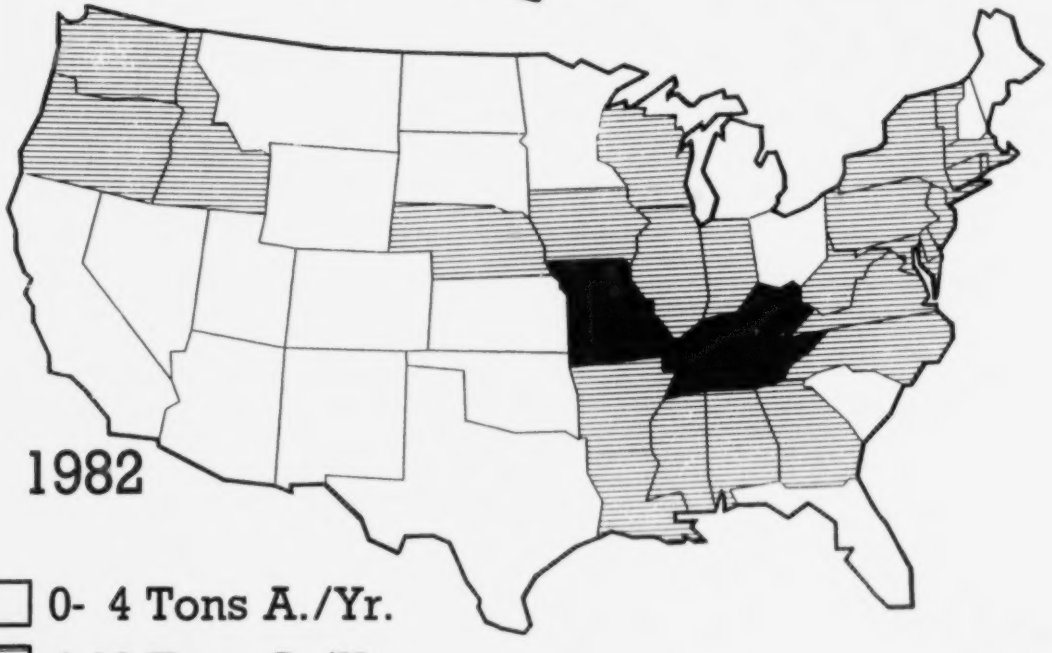
8. Erosion _____ crop yields.

9. Describe the attitude that has led to many agricultural lands being "farmed out."

10. What will happen to agriculture if soil erosion in Missouri and in the U.S. continues at present-day rates?

Sheet and Rill Erosion for Cropland





0- 4 Tons A./Yr.

4-10 Tons A./Yr.

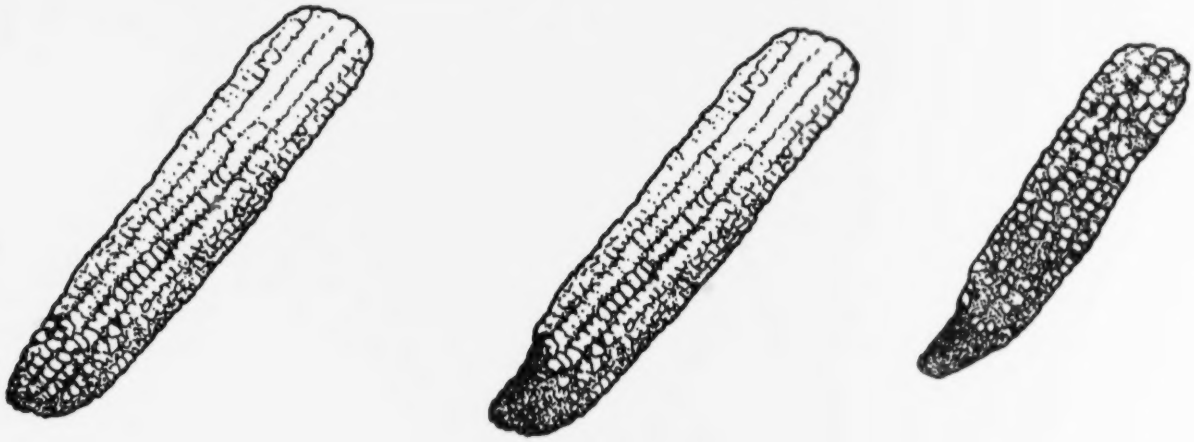
>10 Tons A./Yr.

Credits: Bureau of the Census, U. S. Department of Commerce. 1982 National Resources Directory, USDA.

Erosion vs. Yield Study

Equal Management on Northwest Missouri (Lamoni) Soil

Uneroded	Moderately Eroded	Severely Eroded
12-Inch Topsoil	5-Inch Topsoil	3-Inch Topsoil
180 BU./A.	**127 BU./A.**	**83 BU./A.**



Credit: "Topsoil - Our Vital Resource." Columbia: Missouri Association of Soil and Water Conservation Districts, 1983.

UNIT - SOIL CONSERVATION

Lesson 2: Land Utilization

Objective: The student will list the major land resource areas and their uses in relation to agriculture.

Study Questions

1. **What facts are needed for a land inventory?**

2. **What are the eight land capability classes and their best uses?**

3. **What are the land resource regions and major land resource areas of Missouri?**

References

1. Soil Conservation (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1987.

2. County soil survey (optional)

3. Transparency Master

   a) TM 2.1: Effect of Soil Texture Classification on Relative Resistance to Soil Erosion

UNIT - SOIL CONSERVATION

Lesson 2: Land Utilization

TEACHING PROCEDURES

A. Review

Review the previous lesson.

B. Motivation

It is very important that farmers closely observe the land being farmed. They need to utilize soil surveys and related data to decide the best possible methods of land use for maximum production. Remind students of the classification system established to help determine proper land use.

C. Assignment

D. Supervised study

E. Discussion

1. Discuss with students what factors they need to consider in a land inventory. If possible, work through an inventory of a farm or school test plot. Emphasize the value of a county soil survey. NOTE: Instructors using "Evaluating Missouri Soils" (EC 915) in their classes should note that it is to be revised during 1987-88. National standards were used for the first two questions of this lesson.

What facts are needed for a land inventory?

a) A soil survey or inventory is important in determining the land's capability for various uses.
b) Several factors are important.
   1) The depth of soil material is the topsoil and subsoil combined, where plant roots live. It is determined by use of a soil probe, auger or spade.
      (a) Deep: if soil area of favorable growth is 40 inches or greater
      (b) Moderately deep: if a restrictive layer lies 20-40 inches from the topsoil
      (c) Shallow: if a restrictive layer lies within 20 inches or less of the topsoil
   2) Air and water permeability refers to the relationship or exchange of air and water in the soil.
      (a) Rapid: faster than desired. Allows two inches of water or more to pass through in an hour. Tends to be droughty.

(b) Moderate: most favorable water and air movement. Allows .6-2.0 inches of water per hour to pass through. Permits adequate movement but retains enough water to withstand periods without rain.
(c) Moderately slow: slower movement than desired. Allows only .2-.6 inches of water per hour to pass through. Soils cold and damp in spring.
(d) Slow: slow water and air movement. Allows .06-.2 inches of water per hour to pass through. Plant growth often delayed because of cold, wet conditions.
(e) Very slow: soils waterlogged for significant periods of time. Allows less than .06 inches of water to pass through per hour. Not well adapted for many crops.

3) The color of surface soil is an important clue to the inherent fertility of a soil.
(a) Dark: Dark brown to black-colored surface soils usually indicate high natural fertility.
(b) Moderately dark: Dark gray to grayish brown soils indicate moderate natural fertility.
(c) Light: Brownish gray to light gray soils indicate low or very low natural fertility.

4) Soil texture refers to the size of soil particles (TM 2.1).
(a) Silty: good combination of clay, sand and silt
(b) Clayey: so much clay that soil is sticky. Often heavy when wet and hard when dry.
(c) Sandy: coarse texture; soil will not hold together. Individual grains visible. Requires a lot of water and fertilizer for good plant growth.

5) Slope is an important factor as it influences the speed water moves over a field. It is measured per 100 feet.
(a) Nearly level: falls less than two feet
(b) Gently sloping: slopes fall 2-5 feet
(c) Moderately sloping: slopes 5-9 feet
(d) Strongly sloping: slopes 9-14 feet
(e) Moderately steep: falls 14-20 feet
(f) Steep: land that slopes 20-35 feet

6) The degree of erosion is determined by the amount of topsoil remaining.
(a) No apparent erosion
(b) Moderate erosion: top 6-7 inches mostly original topsoil with a few spots of subsoil exposed
(c) Severe erosion: top 6-7 inches of soil mixed topsoil and subsoil
(d) Very severe erosion: topsoil nearly gone; top 6-7 inches mostly subsoil
(e) Very severely gullied: topsoil nearly gone; many gullies

2. Discuss the eight land capability classes for agricultural land use. If possible, visit sites that represent some of these classifica-

tions, especially those that are tillable. Refer to a soil survey map of the area(s), if possible. The detail in which this question is discussed will vary based on local conditions.

What are the eight land capability classes and their best uses?

a) U.S. Department of Agriculture has classified land into eight classes; the first four are suitable for cultivation, and the last four are not.
   1) Class I (colored light green on land capability maps)
      (a) Little or no permanent limitations or risk of damage
      (b) Cultivated safely with ordinary good farming methods
      (c) Deep
      (d) Nearly level
      (e) Productive
   2) Class II (yellow on land capability maps)
      (a) Land is subject to moderate limitations in use and moderate risk of damage.
      (b) Land is gently sloping, subject to moderate erosion or subject to occasional overflow.
      (c) Land requires some special attention when cultivated, i.e., soil conserving rotations, water control devices or special tillage methods.
   3) Class III (colored red on capability maps)
      (a) This class is subject to severe limitations in cropland use.
      (b) Soils in this class are moderately to strongly sloping and are subject to more severe erosion or to frequent overflow with crop damage.
      (c) Limitations and appropriate conserving practices often restrict choice of crop, planting time and tillage operations.
      (d) A combination of conservation practices is needed to farm land safely.
   4) Class IV (blue on land capability maps)
      (a) Has very severe permanent limitations or hazards if used for cropping
      (b) May be cultivated if handled properly
      (c) Frequently has steep slopes and is subject to severe erosion; soils shallow or moderately deep
      (d) Best suited for hay, permanent pasture or forest; only occasionally planted to row crops
   5) Class V (colored dark green on land capability maps)
      (a) Should be kept in permanent vegetation and used for pasture or forestry
      (b) Cultivation not feasible because of wetness, stoniness or other limitations
      (c) Land nearly level
      (d) Subject to only slight erosion if handled properly
   6) Class VI (orange on land capability maps)
      (a) Similar to Class V in uses

(b) More limited than Class V by steeper slopes or excessive stream bank cutting

7) Class VII (brown on land capability maps)
   (a) Soils are subject to severe limitations or hazards when used for grazing or forestry.
   (b) Land is steep, eroded, rough, shallow-soiled and/or swampy.
   (c) If used for grazing or forestry, strict management practices must be applied.
8) Class VIII (purple on land capability maps)
   (a) Too rough for even woodland or grazing
   (b) Use limited to wildlife, recreation or watershed uses.

3. Using the SCS poster, discuss with students the major land resource areas of Missouri and their uses. Pay particular attention to the students' local area(s).

What are the land resource regions and major land resource areas of Missouri?

a) Missouri has a great diversity of soil types, which influences the choice of crops, agricultural practices and equipment.
b) Missouri is divided into four land resource regions, which are further divided into land resource areas.
   1) Central Feed Grains and Livestock Region
      (a) Deep Loess Hills (LRA M107 and M108): gently rolling to steep slopes; heavily cropped; erosion rate among the highest in the state for these 8-9 counties
      (b) Heavy Till Plain (LRA M109): cultivated crops typically found on gently sloping uplands and bottom land, with pasture and trees on steep slopes; fine-textured, loess soils highly eroded
      (c) Cherokee Prairies (LRA M112): nearly level to gently sloping region; deep claypan and shallow silty soils; area intensively farmed
      (d) Central Claypan (LRA M113): nearly level to gently sloping; thick loessal materials; 60-70% of area in cropland
      (e) Central Mississippi Valley Wooded Slopes (LRA M115): Chariton River Valley, Mississippi and Missouri River areas; loess around the rivers
   2) East and Central General Farming and Forest Region
      (a) Ozark Highland (LRA N116A): wide range of soils; erosion a major problem because of thin topsoil and infertile subsoils
      (b) Ozark Border (LRA N116B): wide range of soils; cultivated crops found in upland areas and narrow valleys, with pasture and forest on steep sideslopes; loss of all topsoil in some Ozark locations due to poor management

3) Mississippi Delta Cotton and Feed Grains Region
   (a) Southern Mississippi Valley Alluvium (LRA 0131): predominantly in the Bootheel; deep soils varying in texture; wind erosion a major problem

4) South Atlantic and Gulf Slope Cash Crop, Forest and Livestock Region
   (a) Southern Mississippi Valley Silty Uplands (LRA P134): known as Crowley's Ridge; sloping land forms loess mantle over silty, sandy and gravel deposits; third most eroded area in Missouri

F. Other activities

G. Conclusion

A soil survey or inventory is used to determine the land's capability for various uses. One must consider the depth of soil, air and water permeability, color of surface soil, soil texture, slope and degree of erosion. The Soil Conservation Service has classified land into eight classes according to land capabilities. Missouri is divided into four land resource regions. All factors must be taken into consideration so land may be utilized to its full potential.

H. Competency

List major land resource areas and their uses.

I. Answers to Evaluation

1. A soil survey or inventory is important in determining the land's capability for various agricultural uses.

2. Depth of soil material
   Air and water permeability
   Color of surface soil
   Soil texture
   Slope
   Degree of erosion

3. Answers should be based on the parts of Study Question 3 relative to land resource areas in the locality.

4. a
5. c
6. h
7. b
8. d
9. e
10. f
11. g

Name _____

UNIT: SOIL CONSERVATION Date _____

Lesson 2: Land Utilization

EVALUATION

1. Explain the importance of a soil survey or inventory.

2. List six important factors involved in a soil survey or inventory.

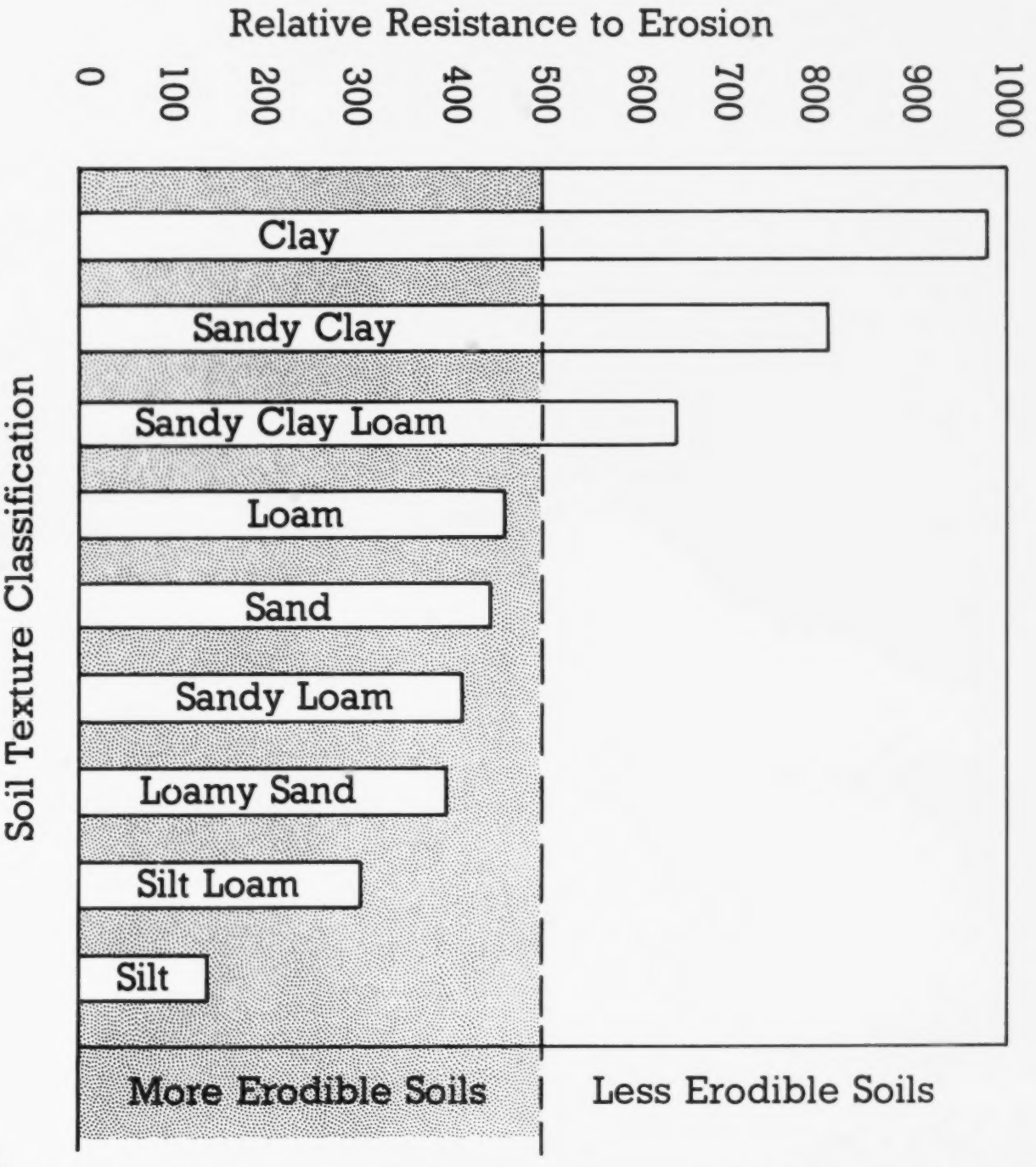
3. Identify and describe the land resource area or areas in your locality.

Matching: Write the letter of the appropriate class of soil in the blank provided before its description.

4. ____ Land nearly level, deep, productive
5. ____ Combination of conservation practices needed to farm land safely; restricts choice of crops
6. ____ Land too rough even for woodland or grazing; suitable only for wildlife or recreational purposes
7. ____ Land gently sloping and subject to moderate erosion; may require soil conserving practices
8. ____ Generally, soils should be in sod or permanent pasture; only occasionally planted to row crops
9. ____ Should be used for pasture or forestry; cultivation not feasible because of limitations
10. ____ Steep slopes, excessive stream bank cutting; land not cultivated
11. ____ If the land is used for grazing or forestry, strict management practices applied

a. Class I
b. Class II
c. Class III
d. Class IV
e. Class V
f. Class VI
g. Class VII
h. Class VIII

Effect of Soil Texture Classification on Relative Resistance to Soil Erosion



Credit: Beasely, R. P.; James M. Gregory; Thomas R. McCarty. Erosion and Sediment Pollution Control, 2nd ed. Ames: Iowa State University Press, 1984.

UNIT - SOIL CONSERVATION

Lesson 3: How Soils Are Eroded

Objective: The student will be able to describe the erosion process.

Study Questions

1. **How are soils eroded by water and wind?**

2. **What is the difference between geological and accelerated erosion?**

3. **How much soil is lost in Missouri due to different types of erosion?**

References

1. Soil Conservation (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1987.

2. Transparency Master

   a) TM 3.1: Average Annual Erosion

3. Visuals

   a) "Soil Erosion" slide series, IML
   b) Soil Samples kit, IML

4. "Teaching Soil and Water Conservation" (PA-341). Soil Conservation Service.

UNIT - SOIL CONSERVATION

Lesson 3: How Soils Are Eroded

TEACHING PROCEDURES

A. Review

Review the previous lesson.

B. Motivation

Ask the students why rivers, creeks and ponds turn muddy after a rain. Generate discussion on why it might be important to learn why soils are eroded.

C. Assignment

D. Supervised study

E. Discussion

1. Discuss with students how soils are eroded by water. Write their ideas on the board. Ask the students if they have observed the effects of erosion caused by water or wind and ask them to relate their experiences. Discuss why tilled land loses more topsoil than permanent pasture.

How are soils eroded by water and wind?

a) Water: the single most erosive force in Missouri's soil erosion problem
   1) Rainfall, streams and rivers all have enormous power to move soils.
   2) A drop of rain striking bare soil can splash more than two feet high and five feet laterally, falling as fast as 20 mph.
   3) Sheet erosion
      (a) Uniform removal of a soil from an area by raindrop splashes and water runoff
      (b) Soil removed in thin layers
      (c) Occurs gradually so is often unnoticed
   4) Rill erosion
      (a) Forms small, well-defined cuts in the land surface less than 12 inches deep
      (b) Occurs primarily in recently tilled areas
      (c) Causes of sheet and rill erosion
         (1) Cultivating land not suited for cultivation (Land Capability Classes V-VIII)
         (2) Not using a conservation cropping system such as crop rotation

(3) Farming row crops up and down a field
(4) Not maintaining good residual cover
(5) Using poor or improper tillage methods

5) Gully erosion
   (a) Severe erosion in which trenches are cut to a depth of more than 12 inches
   (b) Generally, ditches too deep to cross with farm equipment
   (c) May range in depth from 1 to 100 feet
   (d) Causes of gully erosion
      (1) Develop where steep, erodible land is farmed
      (2) Develop where there is a concentration of runoff and where vegetative cover has been disturbed (i.e., livestock trails, farm roads, plow dead furrows

b) Wind erosion
   1) Fine, sandy soils on wide, flat, smooth fields have the greatest potential to blow in Missouri.
   2) Soils with smooth surfaces and easily moved particle size are most susceptible.
   3) Soils with no cover crop are susceptible.
   4) Wind erosion in Missouri is less of a problem than water erosion.
      (a) Adequate rainfall and topography
      (b) More prevalent in the plains states, such as Texas and Oklahoma

2. Discuss with the students the difference between geological and accelerated erosion. Write their ideas on the board. If possible, plan a field trip to areas where students can see examples of geological and accelerated erosion.

What is the difference between geological and accelerated erosion?

a) Geological erosion has always taken place and always will since it is an aspect of geological change.
b) Geological erosion occurs naturally, without the influence of man.
   1) Results from the forces of nature
   2) Results from hundreds of years of smoothing and leveling of rock and soil
   3) Includes not only soil erosion but soil formation from the gradual breakdown of rock
      (a) The formation of one inch of quality topsoil for agriculture use takes 150-1,000 years under the best conditions.
      (b) The formation of 5-10 inches of topsoil necessary for field crops requires many generations.
c) Accelerated erosion is man-made erosion, resulting from man-made practices such as agriculture.
   1) Nearly all agricultural practices accelerate the natural processes of erosion.

2) Soil conservation is the attempt to control needless erosion.

3. Using TM 3.1, discuss with students the extent of various types of erosion problems throughout Missouri. Pay particular attention to the types of erosion problems particular to your area of the state.

How much soil is lost in Missouri due to different types of erosion?

a) Sheet and rill erosion for tilled land
   1) Allowable average soil loss for Missouri cropland has been estimated at 3-5 tons per acre per year.
      (a) Visual perception of soil loss can be very difficult as a five-ton-per-acre loss is about the thickness of a sheet of paper.
      (b) Twenty tons per acre amounts to about 1/8 inch of soil.
   2) At 11 tons per acre, sheet and rill erosion exceeds the allowable average throughout Missouri and runs as high as 50 tons per acre per year in some areas.
   3) In just a few years, this loss could have a significant effect on crop production.

b) Sheet and rill erosion for permanent pastures within allowable limits
   1) 1982 SCS statistics show an average annual soil loss of 2.2 tons per acre for pastureland.
   2) An average annual soil loss of 3.0 tons per acre was reported for rangelands.

c) Gully erosion problem areas in Missouri
   1) Very severe gully erosion loses 500-750 tons of soil per square mile.
   2) A 1978 report found areas with as high as 2,000 tons per square mile in large areas of northwest Missouri.

F. Other activities

1. Lab exercise: Set up samples of sod, loose soil, clay and soil with organic residue. (A Soil Samples kit with approximately 400 ml samples of various kinds of soil may be ordered from IML.) Use a mister and a watering can to illustrate soft rain and hard rain. Also set the exercise up to show different degrees of slope. Have students record observations.

2. See the SCS publication PA-341, "Teaching Soil and Water Conservation," for additional lab experiment and science fair ideas.

3. Show the IML slide set, "Soil Erosion," to illustrate types and effects of erosion.

G. Conclusion

Erosion takes place naturally by the forces of wind and water. Agricultural practices of man accelerate the process of erosion. In Missouri, a large amount of topsoil is lost to sheet, rill and gully erosion on tilled land. By managing agricultural practices, man can slow the process of accelerated erosion.

H. Competency

Describe how soils are eroded.

I. Answers to Evaluation

1. b or c
2. a
3. d
4. c
5. a
6. c
7. d
8. d
9. c
10. d

Name _____

UNIT - SOIL CONSERVATION Date _____

Lesson 3: How Soils Are Eroded

EVALUATION

Write the letter of the correct answer in each blank.

1. ____ Forms well-defined cuts less than 12 inches deep in land
2. ____ Develops where steep, erodible land is farmed
3. ____ Occurs in areas with high prevailing winds and low annual rainfall
4. ____ Is the removal of soil in thin layers by water
5. ____ Forms trenches to a depth greater than 12 inches
6. ____ Uniform removal of soil by raindrop splashes

a. Gully erosion
b. Rill erosion
c. Sheet erosion
d. Wind erosion

Circle the letter of the best answer.

7. Which of the following best describes geological erosion?

   a. Rain carrying soil away from plowed fields
   b. Wind blowing soil away from barren wheat fields
   c. Concentrated runoff from a feedlot
   d. The natural occurrence of erosion and soil formation

8. What is the single most erosive force to Missouri soils?

   a. Farm machinery
   b. Livestock
   c. Wind
   d. Water

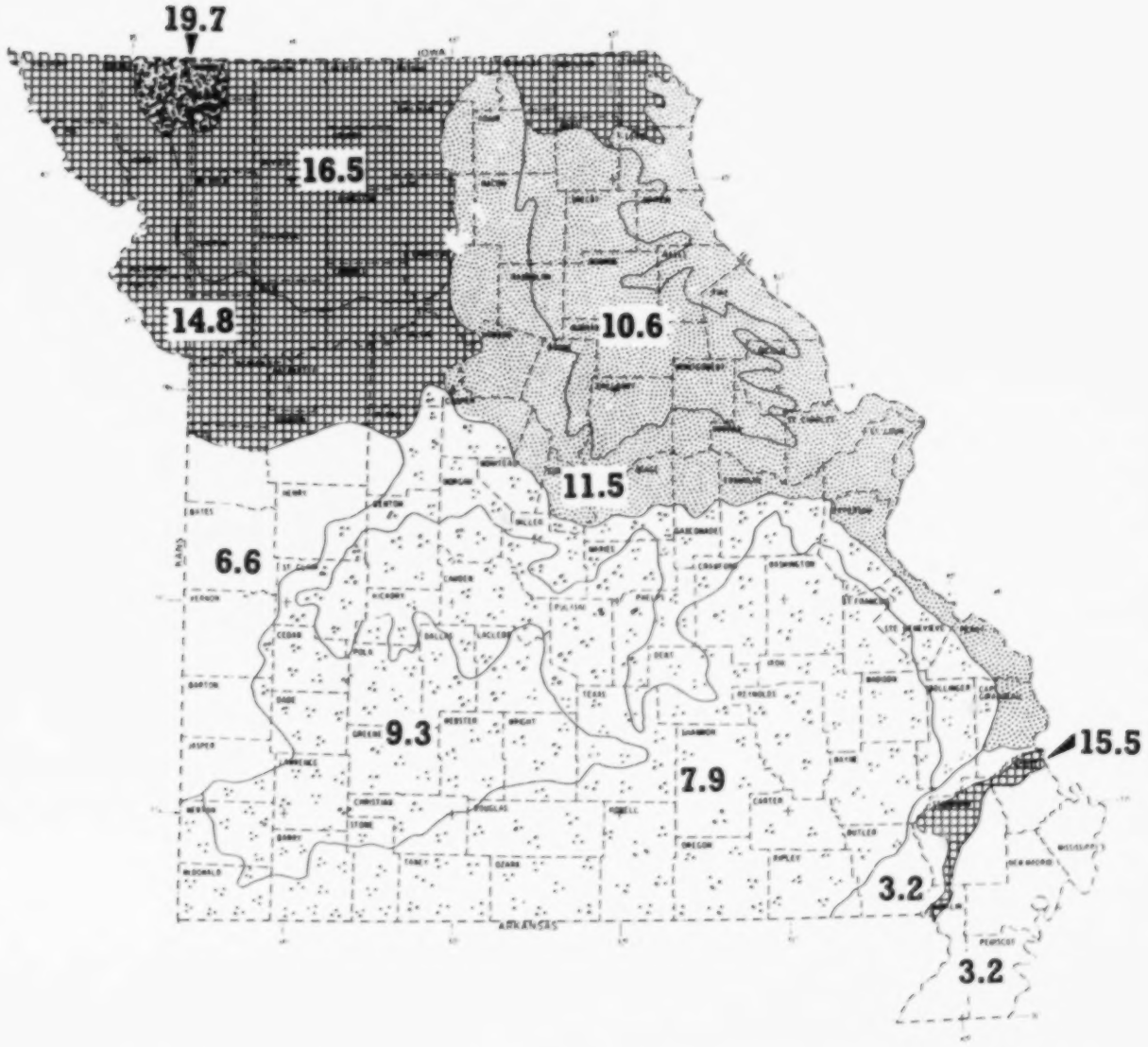
9. The allowable average soil loss for Missouri cropland has been estimated at _____ tons per acre per year.

   a. 1-2
   b. 2-3
   c. 3-5
   d. 6-7

10. How many years does it take to form one inch of topsoil needed to produce good yields?

a. 10-40
b. 30-60
c. 75-100
d. 150-1,000

Average Annual Erosion*
(tons per acre)



*Figures given for cultivated cropland by major land resource area.

Credit: 1982 National Resource Inventory. Soil Conservation Service, USDA.

UNIT - SOIL CONSERVATION

Lesson 4: Cropping and Reduced Tillage Systems

Objective: The student will list cropping and tillage systems important in conserving soils.

Study Questions

1. **How is reduced tillage important in minimizing soil loss?**
2. **How can contour farming minimize soil loss?**
3. **How can strip cropping minimize soil loss?**
4. **How can crop rotation minimize soil loss?**

References

1. Soil Conservation (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1987.
2. Transparency Masters
   a) TM 4.1: Equipment Tillage Triangle
   b) TM 4.2: Surface Residue Remaining After Tillage Operations

UNIT - SOIL CONSERVATION

Lesson 4: Cropping and Reduced Tillage Systems

TEACHING PROCEDURES

A. Review

Review previous lesson.

B. Motivation

Ask the students what kind of farming systems are used on farms they have had experience with or seen. Then ask them how these systems help to control soil erosion and to benefit wildlife.

C. Assignment

D. Supervised study

E. Discussion

1. Using TM 4.1 and 4.2, discuss with students the reduced tillage methods used to conserve soil. Write their ideas and experiences on the board.

How is reduced tillage important in minimizing soil loss?

a) Eliminates one or more tillage operations from a conventional tillage program
b) Important functions of reduced tillage
    1) Controls erosion
    2) Reduces soil compaction
    3) Improves soil aeration, permeability and soil condition
    4) Retards the deterioration of soil structure
    5) Requires less fuel and labor
    6) Provides wildlife with more food and cover during winter months
c) Methods used in reduced tillage
    1) Chisel plant
        (a) Chisel planting uses a chisel plow or field cultivator.
        (b) The soil is broken up or loosened without being inverted.
        (c) Most crop residues remain on the surface, reducing erosion.
    2) Strip till
        (a) Disturbs a narrow soil strip to provide a seedbed for crop being planted
        (b) Generally done with a small section of rotary hoe for each crop row

(c) Good method for cotton

3) Ridge-till
   (a) Method of seedbed preparation by scalping the old row crop with its residue and pushing it into interrows
   (b) Soil loss protection from clods and residue

4) No-till
   (a) Produces crops by planting without seedbed preparation
   (b) Crops planted into existing cover crop, sod or crop residues, eliminating subsequent tillage operations

d) Effectiveness of reduced tillage methods will depend on the amount of crop residue left on surface and mixed in top few inches.
   1) Because residue is related to the previous crop, evaluate the cropping system and the tillage method together.
   2) Effectiveness levels of various covers differ.

2. Discuss with students how contour farming reduces soil erosion.

How can contour farming minimize soil loss?

a) Contour farming is any method of land preparation, planting and cultivating that is done on the contour.
b) By itself, contour farming can reduce soil losses by half over up-and-down-hill farming on flatter slopes of 2-8%.
c) Gullying may develop as water follows furrows and concentrates in low areas.
   1) Generally only a problem if contouring is deviated from
   2) Install waterways at concentrated water areas
d) It is often advisable to use contour farming in combination with other practices.

3. Discuss with students how strip cropping can reduce soil erosion. Draw diagram on board.

How can strip cropping minimize soil loss?

a) Growing crops in a systematic arrangement of crops planted in strips to reduce erosion
b) Grass or small grain grown in alternating strips of row crop
c) Grass or small grain strip acts as a filter to slow runoff, reducing sediment loss on row crop strips
d) Strips established on the contour or across-slope

4. Discuss with students how crop rotation can reduce soil erosion.

How can crop rotation minimize soil loss?

a) Crop rotation refers to an orderly sequence of growing crops.
   1) Provides soil cover
   2) Improves soil fertility
   3) Increases soil moisture storage

4) Helps reduce pest problems without pesticide usage, which lessens poisoning threat to wildlife

b) Row crops may be rotated together or row crops may be rotated with legume or grass pasture and small grains.

c) Level of erosion control will vary depending on crop rotation and other management practices.

F. Other activities

If possible, visit a site that uses these conservation practices.

G. Conclusion

Different cropping systems are important to consider for minimizing soil loss. Reduced tillage, contour farming, strip cropping and crop rotation help to control soil erosion. Each system should be analyzed to determine which system should be used in a farming operation.

H. Competency

List cropping and tillage systems which are important in conserving soil.

I. Answers to Evaluation

1. b
2. d
3. a
4. c
5. a
6. a
7. d

8. Conventional tillage refers to a maximum tillage operation. Reduced tillage eliminates one or more tillage operation from a conventional tillage program.

9. Any three of these functions:
   a) Retards deterioration of soil structure
   b) Reduces soil compaction and formation of tillage pans
   c) Improves soil aeration, permeability and tilth
   d) Controls erosion
   e) Requires less fuel and labor

Name _____

UNIT - SOIL CONSERVATION Date _____

Lesson 4: Cropping and Reduced Tillage Systems

EVALUATION

Match the cropping systems on the right with the correct description on the left by placing the letter in the correct space.

1. ____	Preparing a narrow strip of soil for seedbed	a. Chisel plow
2. ____	Residue pushed into interrow area	b. Strip till
3. ____	Breaks up or loosens the soil without inverting the soil	c. No-till
4. ____	Produces crop without seedbed preparation	d. Ridge-till

Circle the letter which best answers the question.

5. Which of the following best defines crop rotation?

   a. Growing crops in an orderly sequence
   b. Land planted and cultivated on the contour
   c. Growing crops in a systematic arrangement of strips across the slope
   d. Growing the same crop year after year

6. Which of the following describes conservation tillage?

   a. Reduces soil or water loss
   b. The same as conventional tillage
   c. Consists of leaving crop residue on the field during the winter and then preparing a clean seedbed in the spring before planting
   d. All of the above

7. Which of the following is <u>not</u> a conventional tillage operation?

   a. Moldboard plowing
   b. Harrowing
   c. Cultivating
   d. No-till planting

8. Explain the difference between conventional tillage and reduced tillage.

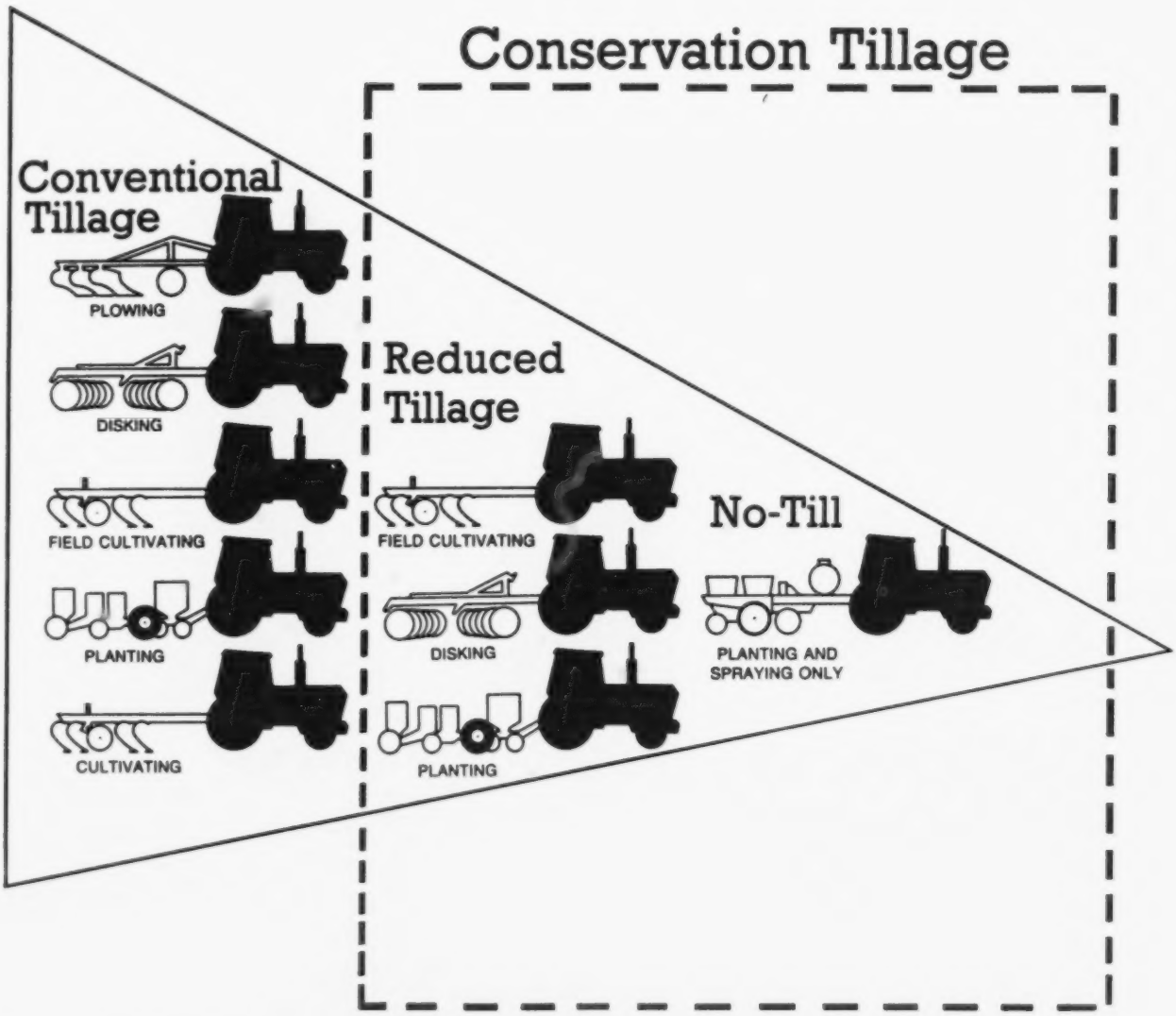
9. List three functions of reduced tillage.

   a.

   b.

   c.

Equipment Tillage Triangle



Credit: Adapted from Fundamentals of No-Till Farming. Athens, Georgia: American Association for Vocational Instructional Materials, 1983.

Surface Residue Remaining after Tillage Operations

Tillage system	Percentage of residue from previous crop remaining			
	Corn	Soybeans	Small grain	Sod
Moldboard plow, disk, field cultivate	5	2	5	10
Chisel (4" twisted points), disked twice	15	2	10	20
Chisel (2" straight points), disked twice	20	5	15	25
Primary tillage disk (deeper than 6"), disked twice (standard tandem)	10	5	15	20
Shallow disking (less than 6")				
once (standard tandem)	40	20	45	50
twice (standard tandem)	20	10	25	30
Ridge-till	30	20	NA	NA
In-row subsoil, plant	70	50	80	85
No-tillage plant	80	60	90	95

Credit: Griffith, Donald; Jerry Mannering; J. E. Box. "Soil and Moisture Management with Reduced Tillage," No-Tillage and Surface Tillage Agriculture: The Tillage Revolution. New York: John Wiley and Sons, Inc., Copyright © 1986. Used by permission of John Wiley and Sons, Inc.

UNIT - SOIL CONSERVATION

Lesson 5: No-Till Farming

Objective: The student will explain the fundamentals of no-till farming.

Study Questions

1. **What are the potential benefits and the limitations of no-till farming?**

2. **What major crops can be grown using no-till procedures?**

3. **What are the characteristics of no-till planters and drills?**

4. **What do farmers need to consider when choosing a no-till planter?**

5. **What are some operating guidelines for no-till planters?**

References

1. Soil Conservation (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1987.

2. Audiovisual materials

   a) "Soil: A Medium for Plant Growth" slide series by Vocational Education Productions. San Luis Obispo: Calif. Polytechnic State University. Available on loan from Missouri Vocational Resource Center.

   b) "No-Till Farming" slide series available from IML.

   c) "No-Till Corn Production for Conservation Farming" slide series available from IML.

UNIT - SOIL CONSERVATION

Lesson 5: No-Till Farming

TEACHING PROCEDURES

A. Review

Review previous lesson.

B. Motivation

As mentioned in Lesson 4, no-till farming is one system farmers can use in the fight against soil erosion on cultivated land. This challenging approach to farming not only results in the least soil loss, but may also, if properly used, save fuel and farm labor.

C. Assignment

D. Supervised study

E. Discussion

1. Ask students about the advantages and disadvantages of no-till farming they have observed or read about. Write their ideas on the board, formulating a list of the advantages or disadvantages.

What are the potential benefits and the limitations of no-till farming?

a) Potential benefits
   1) Reducing erosion
      (a) Ground cover greatly reduces soil erosion.
      (b) No-till reduces soil loss from wind and water.
      (c) Soil loss is reduced 90-95% over conventional till.
   2) Conserving energy
      (a) Fuel cost is reduced.
      (b) Number of trips made with tractor is reduced.
      (c) Amount of fuel saved varies from area-to-area and farm-to-farm.
   3) Time and labor saved
      (a) Studies show 50-60% reduction in time and labor from using no-till.
      (b) Reduction may not be as high in the first few years when developing the no-till program.
      (c) Labor reduction may be offset by increased management time.
   4) Machinery costs reduced
      (a) If just starting out with little equipment, no-till is beneficial.

(b) Conventional tillage may require eight or more pieces of equipment.
(c) Three basic pieces of equipment--tractor, planter and spray rig--are needed for a no-till program.
(d) No-till may cut power needs in half.

5) Doublecropping
(a) Farmer can harvest two crops off one field in a year.
(b) No-till saves valuable time needed for doublecropping.

6) Conserving soil moisture
(a) Soil is not turned over and exposed to the sun's radiation.
(b) Sod, stubble or crop residue in no-till fields serves to trap water during rain, giving it more time to soak in.

7) Wildlife habitat created
(a) Waste grain provides winter food supply.
(b) Crop residues provide winter cover and nesting habitat.

8) Other benefits
(a) Increases organic matter
(b) Improves soil structure
(c) Reduces crusting
(d) Provides firmer soil conditions at harvest

b) Potential limitations

1) No-till requires more management skills.
(a) Weed control by cultivation is possible, but not as common.
(b) It is often advisable to start small (25-50% of acreage) when developing your no-till system.
(c) Certain weed problems are particularly hard to control with herbicides alone.

2) No-till fields retain more moisture than tilled fields and are generally cooler.
(a) May delay spring planting
(b) Can delay or reduce seed germination
(c) Not as readily adaptable in heavy, poorly drained soils

3) No-till requires careful checking for pests.
(a) Crop residue remaining on surface provides a suitable environment for insects and diseases.
(b) Plowing can destroy some insect larvae.
(c) Cooler, wetter soils encourage the development of many diseases that attack seeds and seedlings.

4) No-till substitutes pesticides for tillage.
(a) Increased pesticide use increases costs, as compared to conventional tillage.
(b) Care must be taken to use pesticides according to label directions to minimize potential environmental hazards.

(c) There are three types of pesticides.
(1) Herbicides: largest category (see Student Reference for more detail)
(2) Insecticides: may pose a threat to wildlife eating chemically killed insects
(3) Fungicides

2. Discuss with students what crops have been successfully grown with a no-till system.

What major crops can be grown using no-till procedures?

a) Corn
1) First no-till crop on a large scale was corn.
2) No-till corn may be planted in dead sod, cover crops or previous crop stubble.
(a) Cover crops may be legumes such as hairy vetch.
(b) Legumes replace the nitrogen that corn removes from the soil.
3) Usually, corn is rotated.
(a) Corn is rotated with legumes and small grains.
(b) Rotation aids in the reductions of weed, insect and disease problems.

b) Soybeans
1) Soybeans rank closely behind corn in total number of no-till acres.
2) Singlecropping involves planting full-season soybeans into a cover crop or previous crop residue.
3) Doublecropping soybeans behind small grains has proven successful.
(a) No-till saves time, allowing soybeans to be planted very quickly after small grain harvest.
(b) Stubble conserves moisture.

c) Grain sorghum
1) Singlecropped or doublecropped behind small grains
2) Same production practices and savings as soybeans

d) Alfalfa and other forage legumes
1) Seeded directly into small grain stubble
2) Allows dairy and livestock producers a good crop rotation
(a) Harvest both grain and straw crop
(b) Put field into alfalfa production, then into corn production
(c) Return field to small grain production

e) Pasture renovation
1) Pastureland often does not produce to full potential.
2) Conventional means often not feasible without increased erosion potential.
3) No-till system involves seeding legumes or improved grasses into existing sod.
(a) Reduce existing sod by mowing, grazing closely or spraying with contact herbicide.
(b) New seedling competition is reduced.

f) Small grains
   1) Winter-seeded grains such as wheat, barley, oats and rye are often easiest to no-till.
   2) Small grains may be planted into previous crop stubble or into sod or pasture.
   3) Avoid planting with no-till in fields infested with hard-to-control perennials.
   4) If planting into corn stalks, it may be advisable to chop stalks before planting.

3. Discuss with students the basic characteristics of no-till planters and some of the various types of machinery available. If possible, visit implement dealers and have students observe no-till equipment firsthand.

What are the characteristics of no-till planters and drills?

a) Basic requirements of no-till planters
   1) Be heavy and sturdy enough to cut through previous crop residue or sod
   2) Provide a narrow band of tilled soil to receive seed
   3) Plant seed at a preselected, uniform depth
   4) Cover and firm soil around the seed
   5) Measure seed distance accurately
   6) Row depth flexibility to suit different crops

b) Parts of planters
   1) Coulters
      (a) Cut through stubble residue and/or sod
      (b) Three types: smooth, wide fluted and narrow or ripple (generally preferred)
      (c) Adjustable three ways
   2) Residue-moving devices
      (a) Heavy residue interferes with planting.
      (b) Devices such as multiple coulters, rake tines and V-shaped discs move residue to the side.
   3) Seed openers
      (a) Open seed furrows behind coulter
      (b) Three types: disk, shank and slot
      (c) Double disk most popular
   4) Press wheels
      (a) These tools firm the soil over and around the seed.
      (b) Press wheels are important for covering seeds.
      (c) Proper weight, spring down pressure and slower driving speed ensure proper seed-to-soil contact.

c) Many planters are set up to apply fertilizer, granular insecticide and seed all in one pass.

d) Other no-till planting equipment
   1) Pasture renovation drills
   2) Heavy residue cultivators
   3) No-till anhydrous applicators

4. Discuss with the students what factors they would consider to help them choose the right no-till equipment for their farming needs.

What do farmers need to consider when choosing a no-till planter?

a) No-till planters and drills are more expensive than other planters and drills; however, the farmer will need to purchase less machinery than with conventional tillage.
b) There are steps the farmer should take before choosing a planter.
    1) Consider particular needs.
        (a) Type of crop planted
        (b) Soil type
        (c) Farming methods
    2) Consider the size needed.
        (a) 2-16 rows or more available
        (b) No-till planting slower than conventional till planting
        (c) Larger planter needed for farming many acres
        (d) For irregular or rough fields, four- to six-row usually best
        (e) Tractor's horsepower important to consider. Rule of thumb: a no-till planter requires 8-10 hp per row
    3) Investigate the market.
        (a) Farm equipment dealers
        (b) Other farmers who own similar equipment
        (c) Extension personnel and meetings
        (d) Soil Conservation Service representatives
    4) Try out planters on the farm before purchasing.
    5) Consider the price, as well as part and repair services availability.

5. Discuss no-till planter operation guidelines with students. If possible, have the students observe a no-till operation on a local farm.

What are some operating guidelines for no-till planters?

a) No-till saves time on every farming operation except planting.
    1) Slower driving speed
    2) Attention to detail
    3) Frequent checking, especially when soil conditions are not uniform
b) Follow guidelines when no-till farming.
    1) Check equipment over carefully; plan ahead.
    2) Check conditions for soil dryness and seed slot closing.
    3) Check the soil temperature. (Soil temperature for corn at seed depth should be 50F at 8 a.m.)
    4) Adjust planter for proper seed depth.
    5) Check the fertilizer placement. (Fertilizer should be placed 1-2 inches below and to the side of the seed.)

6) Check the seeding rate.
   (a) Check seed drop manually by operating planter at planting speed.
   (b) Measure seed drop.
7) Adjust planter weight to maintain even planting depth.
8) Watch operating speed (normally 3-4 mph).
9) Check the operation of the planter frequently.
   (a) Depth of seed placement and spacing
   (b) Alignment of coulter
   (c) Proper fertilizer placement

c) Fertility in no-till systems
1) Test soil fertility.
2) Incorporate fertilizer and lime when needed.
3) Topdress fertilizer and lime before planting.
4) pH in no-till fields is important.
   (a) May decrease when nitrogen fertilizers are applied to surface
   (b) Acidic soils limit root growth, nutrient availability and herbicide activity
5) Take soil samples in the upper two inches to see if surface acidity exists.
6) Take standard soil samples in the upper 6-7 inches for nutrient requirements.
7) More nitrogen is lost in no-till systems when applied to the surface than when injected.
8) When applying nitrogen to surface, increase the recommended rates for conventional tillage by 15%.
9) When applying phosphate and potash, inject the same rates recommended on the soil test.

F. Other activities

Show an appropriate audiovisual, such as one of those listed on the first page of this lesson.

G. Conclusion

No-till farming is a different approach to the basic task of conventional tillage. The crop is planted directly into a seedbed, which has not been tilled since the harvest of the previous crop. No-till farming can reduce soil erosion; conserve energy; and save time, labor and machinery costs. Management must be given careful consideration in no-till because of cooler soil temperatures and increased pest, disease and weed problems. When using the no-till method, farmers need to make adjustments in equipment and follow certain guidelines in planting.

H. Competency

Explain the fundamentals of no-till farming.

I. Answers to Evaluation

1. d
2. b
3. d
4. c
5. c

6. No-till farming is a minimum tillage system. The crop is planted directly into the seedbed, which has not been tilled since the harvest of the previous crop.

7. Any six of the following:
   a) Plan ahead
   b) Check conditions
   c) Check soil temperatures
   d) Adjust planters
   e) Check fertilizer placement
   f) Check seeding rate
   g) Adjust planter weight
   h) Watch operating speed
   i) Check operation of planter frequently

8. Any three of the following:
   a) Corn
   b) Soybeans
   c) Grain sorghum
   d) Alfalfa and other forage legumes
   e) Pasture renovation
   f) Small grains

9. Herbicides, insecticides and fungicides

Name _____

UNIT - SOIL CONSERVATION Date _____

Lesson 5: No-Till Farming

EVALUATION

Circle the best answer for the following questions.

1. Which of the following best describes increased soil moisture in relation to no-till farming?

   a. Potential benefit from using no-till
   b. Potential limitation when using no-till
   c. Partly due to increased organic matter
   d. All of the above

2. On a no-till planter, _____ cut stubble residue or sod.

   a. Furrow openers
   b. Coulters
   c. Disks
   d. Press wheels

3. Which of the following best describes proper no-till row fertilizer application?

   a. Under the seed
   b. Below and to the side of the seed
   c. As a sidedressing during the growing season
   d. a and c

4. What is a good operating speed for no-till planters?

   a. .5-1 mph
   b. 1-2 mph
   c. 3-4 mph
   d. 4-6 mph

5. What is one limitation of no-till farming?

   a. Decreased organic matter
   b. Soil and water loss
   c. Increased pest problems
   d. Time and labor costs

6. What is the definition of no-till farming?

6. What is the definition of no-till farming?

7. List six of the guidelines used in operating a no-till planter.

   a.

   b.

   c.

   d.

   e.

   f.

8. Name three crops that can be grown successfully using no-till.

   a.

   b.

   c.

9. What are the three types of pesticides used in no-till?

   a.

   b.

   c.

UNIT - SOIL CONSERVATION

Lesson 6: Erosion Control Structures

Objective: The student will identify the structures important in conserving soil.

Study Questions

1. **Why are terraces constructed in farm fields?**

2. **What is the difference between the types of terrace outlets?**

3. **What are the advantages and disadvantages of the three main types of terraces?**

4. **How are diversions used in soil conservation?**

5. **How are natural course waterways different from field boundary waterways?**

6. **What are the general functions of the three types of gully stabilizing structures?**

References

1. Soil Conservation (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1987.

2. Transparency Masters

   a) TM 6.1: Underground Outlet
   b) TM 6.2: Types of Terraces

UNIT - SOIL CONSERVATION

Lesson 6: Erosion Control Structures

TEACHING PROCEDURES

A. Review

Review the previous lesson.

B. Motivation

Erosion control structures are **one part** of a farmer's resource management system. The purpose of these structures is to slow the speed of water flow to a non-erosive velocity or to transport water from one stable point to another stable point at a lower elevation. Some systems perform a combination of these purposes. For standards or specifications on particular structures, instructors may wish to contact a local SCS engineer.

C. Assignment

D. Supervised study

E. Discussion

1. Ask students to discuss what terraces are and why they are important to soil conservation.

Why are terraces constructed in farm fields?

a) A terrace is an earth embankment, channel or combination ridge and channel constructed across the slope to decrease slope length and to control runoff.
b) Terraces serve several useful purposes.
   1) Reduce erosion
   2) Reduce sediment content in the runoff
   3) Intercept and conduct surface runoff at a nonerosive velocity to a stable outlet
   4) Retain runoff for moisture conservation
   5) Prevent gully development and improve farmability
   6) Reduce flooding with contouring
c) Sediment reduction may be higher because of sediment deposits behind the terrace or in the grassed waterway.
d) There are several considerations that call for terrace construction.
   1) Contouring alone is often inadequate for control.
   2) There is a need to conserve water.
   3) Runoff and sediment affect water quality or damage land, stream or improvements downstream.
   4) Small gullies are prone to developing in the field.

5) A suitable outlet for the terraces is available or can be provided.
6) The soil and topography are such that terraces can be constructed and farmed with reasonable cost and effort.

2. Discuss with students the two basic types of terrace outlets and how these systems work. Show TM 6.1.

What are the differences between the types of terrace outlets?

a) Terrace with a grassed waterway outlet
   1) When surface flow and runoff occur, the terrace intercepts water and carries it at a nonerosive velocity to the grassed waterways.
   2) The waterway must have a suitable grade and sufficient capacity so grass in the waterway can be properly maintained.
   3) Steeply sloping land may cause water velocities that are too fast.
      (a) Vegetation no longer protects the channel.
      (b) Grade control structures will be need to provide adequate protection.

b) Terrace with underground outlet
   1) Runoff is stored in the terrace channel for a short period of time before being removed through an underground conduit or tile outlet.
   2) Terrace is usually built up to provide adequate storage capacity for a given storm level without overtopping the terrace.
   3) Underground outlets allow for parallel alignment and eliminate the need for grassed waterways. (More land is available for cropping.)

c) Terrace without a constructed outlet
   1) Level terraces work on the principal that water is stored for a period of time and infiltrated into the ground.
   2) The soil must have a rapid absorption level.
   3) Level terraces are primarily found in northwest Missouri.

3. Have students describe the three main types of terraces. Discuss the alignment of terraces and the possibility of using point rows between some terraces. Compare the advantages and disadvantages of each type of terrace. Show TM 6.2.

What are the advantages and disadvantages of the three main types of terraces?

a) Broad base terrace
   1) Advantages
      (a) Entire terrace can be farmed; no land is out of production.
      (b) Less landfill is needed for construction when landslopes are uniform.

(c) Moldboard plows may be used to maintain the ridge height.
(d) Ridge is easier to construct because soil is pushed down the slope.
(e) Adapted to better landslopes of less than 8%.

2) Disadvantages
(a) Final landslope between terraces is steeper than original landslope.
(b) It is more difficult and hazardous to farm with steeper landslopes.
(c) Larger field area is disturbed during construction.
(d) Parallel alignment may be difficult and more costly to construct on irregular land.

b) Steep backslope

1) Advantages
(a) Final landslope between terraces is flatter than original landslope.
(b) Grassed backslope provides food and cover for wildlife.
(c) Terraces are easier to make parallel to each other.
(d) Terraces are adapted to steeper landslopes, which may be greater than 8%.

2) Disadvantages
(a) Steep backslope is seeded with grass and removed from crop production.
(b) Backslope may require periodic control of weeds and burrowing animals.
(c) Care must be taken when operating equipment near the steep backslope.
(d) High ridges may limit field access.
(e) Special care must be taken when applying herbicides next to vegetated slopes.

c) Narrow base

1) Advantages
(a) Less earthfill is needed, and less field area is disturbed during construction.
(b) Final landslope between terraces is flatter than original landslope.
(c) Inlet pipes do not interfere with farming operations.
(d) Vegetation on the entire ridge provides food and cover for wildlife.
(e) Machinery does not operate on or near a steep ridge.
(f) These terraces are adapted to farmable landslopes.

2) Disadvantages
(a) Entire terrace ridge is removed from crop production.
(b) Ridge may require special control of burrowing animals and weeds.
(c) Ridges may limit access within the field.
(d) Sediment may need to be periodically removed from the terrace channel.
(e) Special care needs to be used when applying herbicides next to vegetated slopes.

4. Ask students to discuss how diversions can be used in a soil conservation plan. Illustrate the use of diversions and point out conditions where diversions might be used.

How are diversions used in soil conservation?

a) A diversion is a channel with a lower side ridge constructed across the slope to divert water at a nonerosive velocity to sites where it can be used or disposed of at a stable outlet.
b) Diversions are constructed for many reasons.
    1) Divert water from erosion-prone areas
    2) Divert water from areas where it might become polluted
    3) Divert polluted water to a satisfactory disposal area or facility
    4) Serve in some instances as a sediment trap
c) Diversions should not be used below high sediment-producing areas unless provisions have been made.
    1) Accommodate the rapid sediment accumulation.
    2) Bring sediment-producing areas under control.
d) Diversions are considered for various reasons.
    1) When runoff from higher lying areas damages cropland, pastureland, farmsteads or conservation practices such as terraces or strip cropping
    2) When the diversion is needed to control erosion
    3) Where runoff is available and needed for use on nearby sites such as increasing the effective drainage area above a pond to ensure adequate water supply

5. Discuss the use of natural course and field boundary grassed waterways. List advantages and disadvantages of both on the board.

How are natural course waterways different from field boundary waterways?

a) Natural course
    1) May be natural, well-vegetated draw or natural watercourse that needs to be shaped or enlarged to handle flow of terraces or diversions
    2) Advantages
        (a) Flatter grade in immediate area
        (b) Sometimes ready for immediate use
        (c) Terraces easier to parallel in avoiding point rows
        (d) Sufficient depth available to permit easy outletting
        (e) May require less earth moving to provide adequate channel capacity
        (f) Shorter terraces and less critical channel grades
    3) Disadvantages
        (a) Waterways crossed during farming operations, increasing maintenance
        (b) Generally more problems in maintaining grass cover due to chemical damage from herbicide applications
        (c) May make equipment travel more difficult

(d) If waterway cannot be crossed with farm equipment, the field separated into smaller tracts

b) Field boundary
   1) Constructed watercourse adjacent to field boundary
   2) Not commonly used
   3) Advantages
      (a) Waterway can be located opposite from travelways and entrances.
      (b) Maintenance is reduced since the waterway is not crossed with equipment.
      (c) Accessibility from the farmstead can be more easily obtained.
   4) Disadvantages
      (a) Sharp turns in the terrace systems needed for outletting into waterway
      (b) Impractical for use with large, modern equipment
      (c) Tend to create unnatural water flow
      (d) Greater earth movement required
      (e) Waterway grades often steeper

6. Discuss with students the three types of structures that stabilize gullies and how they can improve farming operations.

What are the general functions of the three types of gully stabilizing structures?

a) Gully stabilizing structures are used to stabilize the grade or to control gully head erosion into a natural or artificial stable channel.
b) Type of structure used will depend on the amount of grade that must be controlled, the size of the drainage area and the site conditions.
   1) Straight drop spillway: a weir drop structure
      (a) Drops water through opening to downstream channel level
      (b) Efficient in controlling maximum of up to 10-feet drops
      (c) Well-suited for sites requiring large flow capacity with little available storage
      (d) Can be constructed with concrete, concrete blocks, metal or wood
   2) Drop inlet spillway: a vertical pipe inlet connected to a horizontal pipe through the embankment of an earth fill dam
      (a) Efficient for controlling relatively deep gullies
      (b) Can use with temporary storage to reduce peak channel flow
   3) Hood or canopy inlet spillway: a pipe placed horizontally through the earth fill; the inlet end of the pipe is placed with the hood or canopy on top and the lower edge at the desired water level in the reservoir.
      (a) Simple to make and install

(b) Low cost
(c) No vertical riser required
(d) Less fill over the pipe as compared to drop inlet spillway
(e) Many in use in Missouri
(f) Adaptable to any gully or valley site where soils are suited for good fill construction

F. Other activities

1. Have students locate a gully, investigate its origin and make recommendations for control. This could be an individual or class project.

2. Construct a gully stabilization structure and observe its effect on erosive action.

3. Tour local farms with various soil conserving structures and interview farmers to find what they consider the advantages and disadvantages of these practices.

G. Conclusion

Many structures can be used to help combat soil erosion and may have particular applications on individual farms. These structures, along with appropriate cropping systems, are seen more and more often throughout Missouri.

H. Competency

Identify structures important for conserving soils.

I. Answers to Evaluation

1. d
2. b
3. a
4. g
5. e
6. d
7. c
8. h
9. f
10. b
11. a

Name _____

UNIT - SOIL CONSERVATION

Date _____

Lesson 6: Erosion Control Structures

EVALUATION

Circle the letter of the best answer.

1. Why are terraces constructed?

   a. Terraces increase the slope length.
   b. Terraces decrease the slope length.
   c. Terraces control runoff.
   d. b and c
   e. a and c

2. Which type of terrace is not commonly used in Missouri?

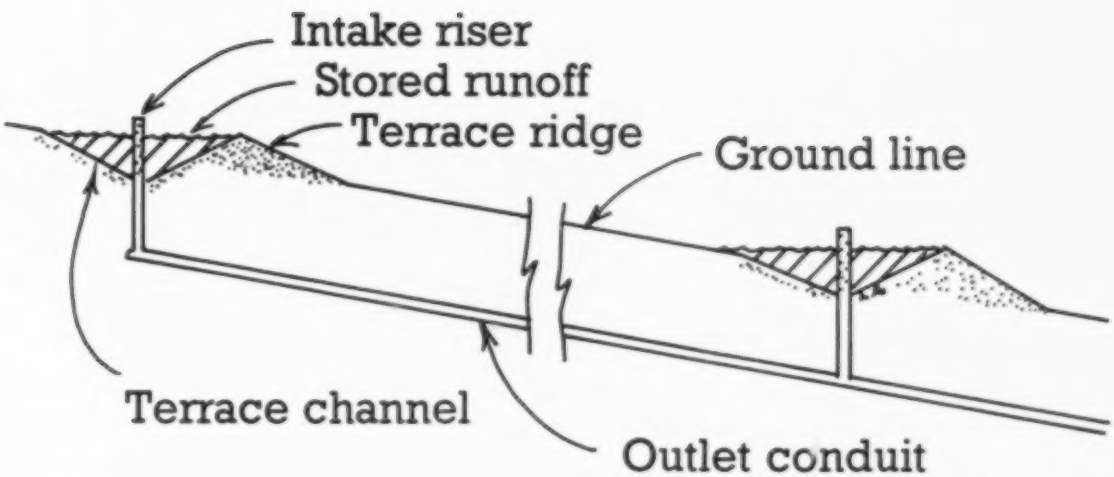
   a. Steep backslope
   b. Bench
   c. Broad base
   d. Narrow base

Match the definition on the left with the term on the right.

4. ____ Runoff stored in terrace channel for short periods of time
5. ____ Above-ground terrace outlet using grass
6. ____ Adapted to landslope greater than 8%
7. ____ Adapted to landslope less than 8%
8. ____ Channels water at a non-erosive force to a stable outlet
9. ____ Natural vegetation or channel which handles the flow of terraces or diversions
10. ____ Constructed watercourse adjacent to a boundary
11. ____ Used to control gully head erosion

a. Gully stabilizing structure
b. Field boundary
c. Broadbase terrace
d. Steep backslope terrace
e. Grassed waterway
f. Natural watercourse
g. Underground terrace outlet
h. Diversion

Underground Outlet

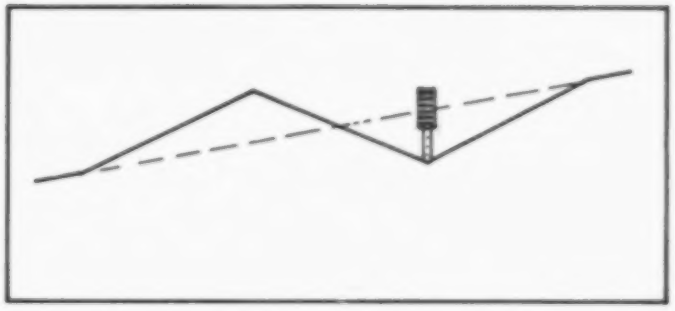


Underground outlet

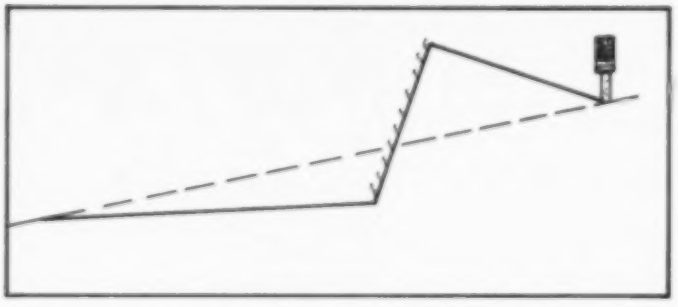
Credit: Beasely, R. P.; James M. Gregory; Thomas R. McCarty. Erosion and Sediment Pollution Control, 2nd ed. Ames: Iowa State University Press, 1984.

Types of Terraces

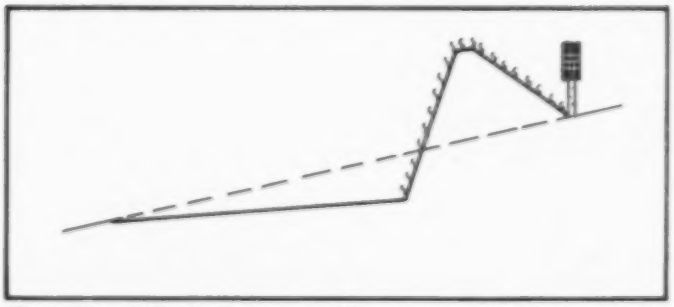
Broad Base



Steep Backslope



Narrow Base



Credit: "Selecting a Terrace." Columbia, Mo.: Soil Conservation Service, USDA.

UNIT - SOIL CONSERVATION

Lesson 7: Universal Soil Loss Equation

Objective: The student will be able to estimate potential erosion in a field using the Universal Soil Loss Equation.

Study Questions

1. **What is the function of the Universal Soil Loss Equation?**
2. **What are the limitations of the Universal Soil Loss Equation?**
3. **What are the components of the USLE?**
4. **What is the T value and how is it and the USLE used to maintain cropland productivity?**
5. **How can the USLE be used to plan a farm soil conservation plan?**

References

1. Soil Conservation (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1987.
2. County soil survey (optional)
3. Transparency Masters
   a) TM 7.1: Basis of Universal Soil Loss Equation
   b) TM 7.2: Universal Soil Loss Equation
4. Work Sheet
   a) WS 7.1: Estimating Soil Loss
5. Computer software (optional)

UNIT - SOIL CONSERVATION

Lesson 7: Universal Soil Loss Equation

TEACHING PROCEDURES

A. Review

Review previous lesson.

B. Motivation

The key to soil conservation is farm use planning with the USLE, a working tool designed to help plan farmland use and cropping practices.

C. Assignment

D. Supervised study

E. Discussion

1. Using TM 7.1, ask the students to discuss what the Universal Soil Loss Equation is and what it is intended to do.

What is the function of the Universal Soil Loss Equation?

a) USLE is a method of evaluating various practices and the effect of their combined use to predict annual soil loss from an individual farm or field.
b) USLE takes into account variability in conditions.
   1) Rainfall
   2) Soil type
   3) Crop rotation
   4) Conservation practices used
   5) Topography
c) USLE helps farmers select practices that will reduce soil erosion.
d) USLE is used by the Soil Conservation Service to develop soil conservation programs.

2. Discuss with students the limitations of the USLE. Emphasize that soil loss figures generated using the equation are only estimates, not absolutes, but that they are the best available estimates.

What are the limitations of the Universal Soil Loss Equation?

a) Soil losses calculated using the USLE are the best available estimates and are not absolute values.
b) USLE estimates soil loss from sheet and rill erosion only (not gully erosion).

c) Soil losses compiled by this formula are not generally the quantities of sediment that actually leave the field.

3. Using TM 7.2, discuss with students the components of the USLE. Thoroughly explain each factor, noting how factors change under different conditions.

What are the components of the USLE?

a) The USLE equation: A = RxKxLSxCxP
b) A = estimated soil loss in tons per acre per year
c) R = rainfall factor
   1) A measure of rainfall energy
   2) A short, intense storm more damaging than the same amount of rain at a slow, steady rate
   3) R factor value for Missouri ranges: 200 for the northern part, 225 for the central part, 250 for the southern part
   4) Intense thunderstorms (gully washers) more common in southern Missouri
d) K = soil erodibility factor
   1) Erodibility factor is a measure of relative resistance of the soil to erosion.
   2) The larger the K value, the easier or more readily that particular soil will erode.
   3) Clay soils are generally less erodible than sandy soils, while silt soils are the most erodible.
   4) Erosion factors for many soil types are provided in Table 7.1 of the Student Reference.
   5) Additional, localized information can be obtained from SCS.
e) LS = slope length and steepness
   1) Steepness and slope length are two very important factors that affect erosion.
   2) The effect of slope steepness and length have been combined to provide the LS factor in Table 7.2, Student Reference.
   3) The LS factor is indicated at the point where the length and the percent of slope intersect. (Table 7.2)
f) C = cropping management factor
   1) As the C value increases, the hazard of erosion increases.
   2) The cropping management factor reflects vegetative cover, crop rotation, fertility level, tillage practices, crop residue management and related conditions that have an effect on erosion.
   3) Selection of the appropriate C for each situation is more difficult than other USLE components as there are more choices.
   4) C value is 1.0 for a continuously bare field.
   5) Conventional tillage C factor is used to get values for conventional moldboard plow systems with various crop rotations and a high level of fertility.
      (a) High fertility = 75+ bu. per acre of corn

(b) Lower fertility results in 10-25% greater soil loss because of lack of residue.

6) Reduced tillage C factor is used to calculate values for conservation tillage.
   (a) As the amount of residue increases on the soil surface, erosion is decreased.
   (b) Tillage decreases surface residue.
   (c) Strip-tilled fields have 33% of the soil surface tilled.
   (d) No-till has only 10% of the soil surface tilled.
   (e) Some estimates of the amount of residue from crop yields are given in the Student Reference.
   (f) There are C components for permanent pastures, rangelands, woodlands and idle land.

g) P = erosion control practice factor
   1) The P factor is the ratio of soil loss from a field with contouring, strip cropping or terracing compared to that of straight up-and-down slope farming.
   2) Contouring is the practice of tilling across the slope.
      (a) Most effective on 2-8% slopes
      (b) Reduces erosion up to 50% compared to up-and-down hill farming
      (c) Benefits negated when slope length limited is exceeded
   3) Contour strip cropping is the practice of alternating strips of sod with row crops or small grain, all planted on the contour.
      (a) Not common in Missouri
      (b) Sod strip traps sediment
      (c) Strip width adjusted for slope
   4) Terracing divides the slope into segments equal to the terrace spacing.
      (a) The LS factor is reduced.
      (b) If crop is planted on the contour with terraces, use the P value from the contour table.

4. Ask students to speculate how tolerable soil loss values affect crop productivity.

What is the T value and how is it and the USLE used to maintain cropland productivity?

a) The T value is the erosion tolerance factor (an acceptable soil loss).
b) In the past, conservation practices have been directed toward maintaining productivity of the land and promoting the economic welfare of the farmer.
c) T values have been selected from all the soils suitable for agricultural use and can be obtained from the Soil Conservation Service.

d) In order to maintain agricultural productivity, acceptable levels of soil loss (T value) have been estimated to range 2-5 tons per acre per year for most soils in Missouri.

5. Lead a general discussion after asking students how they could use the USLE to plan a farm soil conservation program. List specific points on the board. Note that through the equation one can determine the effects of different farming practices. Work through a sample problem with the students.

How can the USLE be used to plan a farm soil conservation plan?

a) It can be used to point out factors that cause erosion.
b) It can be used to present alternatives for controlling erosion.
c) Soil and water conservation plans usually involve a combination of all the various components of the equation dealing with farming practices.
d) Example: Calculate soil loss for a Knox County field on Mexico silt loam (claypan type) soil with a 3%, 300 ft. long slope. Corn and soybeans are rotated. The field is spring plowed (up and down the slope) and the residues are turned under. Yields are usually greater than 75 bu. of corn per acre.
   1) R = 200
   2) K = .40
   3) LS = .6
   4) C = .40
   5) P = 1.0
   6) A = 200x.40x.60x.40x1.0 = 19.2 tons per acre per year

F. Other activities

Present hypothetical farm sites to which the class can use computer software to apply the USLE to make conservation practice recommendations.

G. Conclusion

The USLE is a useful tool for predicting annual soil loss from an individual farm or field. It takes into account rainfall, soil type, crop rotation, conservation practices and topography. The USLE is used by farmers and the Soil Conservation Service in developing soil conservation programs.

H. Competency

Develop a resource management system for a field using the Universal Soil Loss Equation.

I. Answers to Evaluation

1. A = RxKxLSxCxP
2. a
3. d

4. f
5. c
6. b
7. e
8. c
9. c
10. d

J. Answers to work sheet

1. a. A = RxKxLSxCxP
A = 225x.37x.6x.44x.6
A = 13.8

b. T = 3-4. Well above the acceptable soil loss. (13.18-3.4)
This field loses 9.78 tons of soil per acre per year above the accepted level.

c. CxP = T/(RxKxLS)
CxP = 3/(225x.37x.6) = 3/49.9 = .06
Cx.6 = .06 C = .06/.6 C = .1

Choose a system with a C factor of .10 or less. System:
CxCWMM .10

2. a. A = RxKxLSxCxP
A = 225x.37x1.2x.52x.6
A = 31.16 tons per acre per year

b. T factor: 3-4 tons per acre
31.16-4 = 27.16 tons per acre per year

This field loses 9.78 tons of soil per acre per year above the accepted level.

c. CxP = T/(RxKxLS)
CxP = 4/(225x.37x1.2)
CxP = 4/72.9
CxP = .05

Cx.6 = .05
C = .05/.6
C = .083

Choose a system with a C factor of .08 or less.

CCWMMM .079 spring plowed, residue left

Name_____

UNIT - SOIL CONSERVATION Date_____

Lesson 7: Estimating the Universal Soil Loss Equation

EVALUATION

1. What is the formula for the Universal Soil Loss Equation?

Match the letter to the definition that best matches it.

2. ____	Estimated soil loss in tons per acre per year	a. A
3. ____	Rainfall factor	b. P
4. ____	Soil erodibility factor	c. LS
5. ____	Slope length and steepness factor	d. R
6. ____	Erosion control practice factor	e. C
7. ____	Cropping management factor	f. K

Circle the letter which corresponds to the best answer.

8. Which best describes the C factor?

   a. Very easy to select
   b. Never changes
   c. Changes to effectively reduce soil loss
   d. Has little effect on the Universal Soil Loss Equation

9. What is the range for R factor values in Missouri?

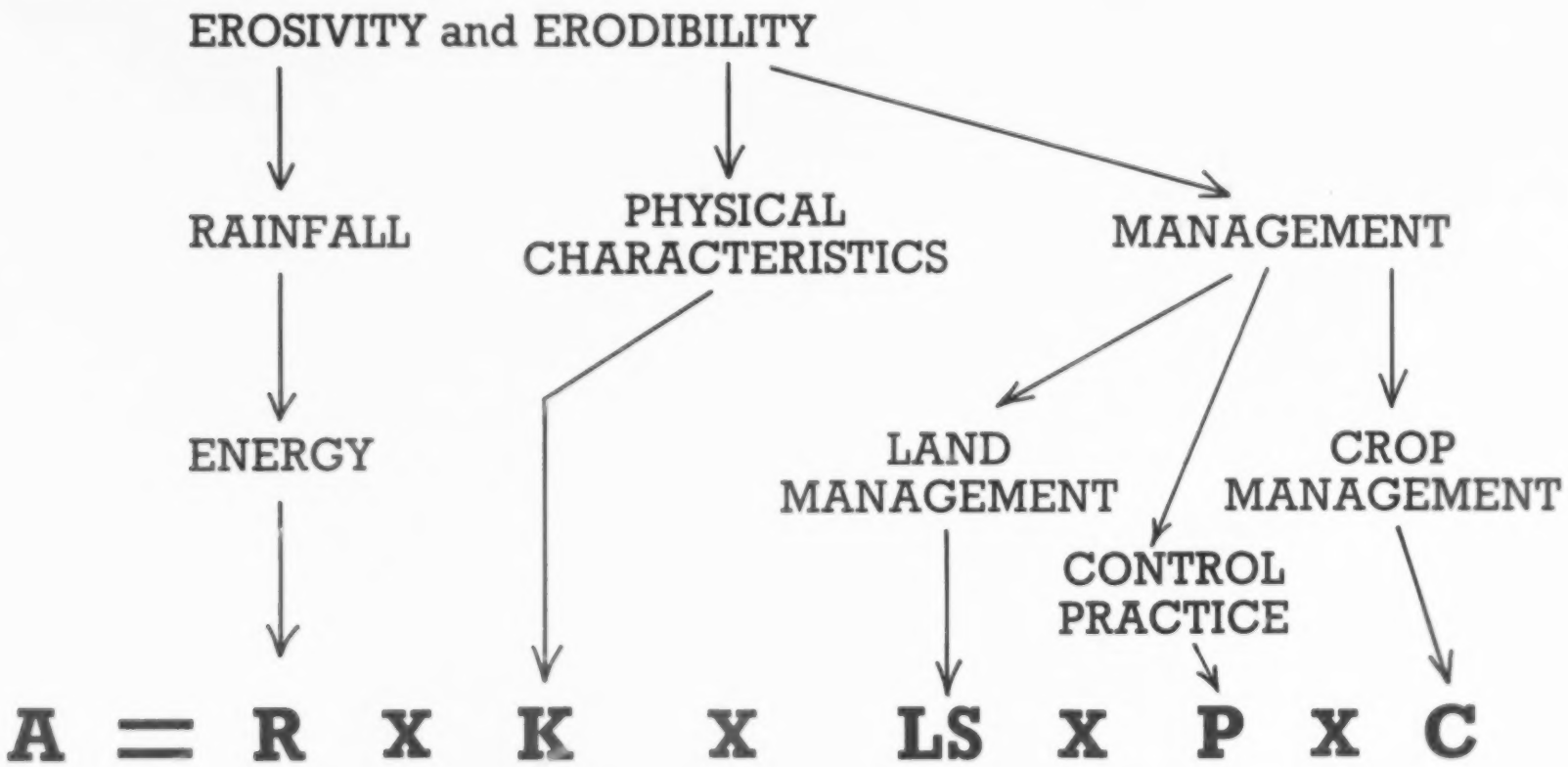
   a. 100-250
   b. 25-125
   c. 200-250
   d. 350-500

10. The erosion control P factor includes what practice?

   a. Contour tillage
   b. Contour strip cropping
   c. Terracing
   d. All of the above

Basis of Universal Soil Loss Equation

Erosion is a function of



Credit: Hudson, Norman. Soil Conservation. Ithaca, NY: Cornell University Press, 1981.

Universal Soil Loss Equation

$$A = R \times K \times LS \times C \times P$$

where
- **A** = the estimated soil loss in tons per acre per year
- **R** = a rainfall factor
- **K** = a soil erodibility factor
- **LS** = the slope length and steepness factor
- **C** = the cropping management factor
- **P** = the erosion control practice factor

Credit: Hudson, Norman. Soil Conservation. Ithaca, NY: Cornell University Press, 1981.

ESTIMATING SOIL LOSS

1. A field in Gasconade County contains a Menfro soil. The field has a 5% slope and is 110 feet in length. Corn and soybeans are rotated. The field is plowed on the contour in the fall.

   a. What is the estimated yearly soil loss in tons per acre?

   b. How much is this soil loss above or below the accepted or tolerable level of soil loss? (T)

   c. What management practices could be used to change the estimated soil loss to an acceptable level?

2. A field in Boone County has Winfield soils. The field has a slope of 8% and is 300 ft. in length. Corn, winter grain and meadows are grown, and spring plowing leaves residue.

   a. What is the estimated yearly soil loss in tons per acre?

   b. Is the soil loss above or below the accepted level of soil loss?

   c. What management practices should be used to bring the soil loss to an acceptable level?

UNIT - SOIL CONSERVATION

Lesson 8: Agency Assistance

Objective: The student will be able to list the agencies that help farmers conserve soil.

Study Questions

1. **What federal, state and local agencies are available to help solve soil erosion problems?**

2. **How do the SCS and the local Soil and Water Conservation District work with farmers to help develop and implement soil conservation strategies?**

References

1. Soil Conservation (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1987.

2. Audiovisual

   a) "Presenting . . . Your Conservation Department." Available on loan from MVRC or Missouri Department of Conservation Film Loan Library, P.O. Box 180, Jefferson City, MO 65102.

UNIT - SOIL CONSERVATION

Lesson 8: Agency Assistance

TEACHING PROCEDURES

A. Review

Review previous lesson.

B. Motivation

Farmers do not have to battle soil erosion alone. The government at all levels has been organized to assist farmers in designing and implementing soil conservation strategies.

C. Assignment

D. Supervised study

E. Discussion

1. Briefly discuss agencies that help farmers conserve soils. For more detail about specific programs, agencies and financial aids, consult the local Soil Conservation Service office or Soil Conservation District office.

What federal, state and local agencies are available to help solve soil erosion problems?

a) Federal: United States Department of Agriculture
   1) Agricultural Stabilization and Conservation Service
      (a) Financial assistance to farmers
      (b) Designed to protect natural resources
   2) Farmers Home Administration: conservation loans
   3) Soil Conservation Service
      (a) Technical assistance to help farmers design and implement conservation practices
      (b) Financial assistance available

b) State
   1) Missouri Department of Natural Resources: direction of Soil and Water Conservation Districts, program development and financial aid administration by the Soil and Water Conservation Districts Commission (an appointed body)
   2) University Extension, University of Missouri
      (a) Conducts research
      (b) Disseminates information
   3) Missouri Department of Conservation
      (a) Conservation planting materials
      (b) Technical assistance to help landowners utilize and conserve fish, forest and wildlife resources

4) Missouri Department of Agriculture: conservation loans

c) Local: Soil and Water Conservation Districts
   1) There are 111 offices throughout the state of Missouri.
   2) These offices provide technical and financial assistance.

2. Discuss in more detail exactly what the SCS and Water Conservation District will do to assist farmers in developing conservation plans. Ask students if they have ever worked with these organizations and to relate their experiences. The instructor may wish to refer back to study question 1 in Lesson 1 or contact SCS for historical background or more current information on the SCS and local conservation districts.

How do the SCS and the local Soil and Water Conservation District work with farmers to help develop and implement soil conservation strategies?

a) SCS technical assistance is available through the Soil and Water Conservation Districts.
b) They can provide a farm-by-farm and field-by-field analysis of a farm system in regard to soil conservation and water management.
c) They will help determine current and projected soil loss using the USLE and other tools.
d) All planning and technical services are free.
e) Once the system is designed, these same agencies can help obtain financial help to establish the system.
f) The Food Security Act of 1985 created a series of soil conservation regulations.
   1) Landowners receiving farm payments are subject to the law's requirements.
   2) There are four components to the law.
      (a) Sodbuster
      (b) Swampbuster
      (c) Conservation Compliance
      (d) Conservation Reserve

F. Other activities

1. Ask an SCS or Water Conservation District representative to speak to the class about ways a farmer can solicit assistance in developing a conservation plan. Also, ask the speaker to give specific step-by-step services that are provided.

2. Ask a representative of an appropriate agency to speak to the class about obtaining financial assistance for implementing a conservation plan.

G. Conclusion

Government agencies have been established to assist farmers in the battle against soil erosion. With help at the federal, state and local levels, farmers can individualize plans for their conservation needs.

H. Competency

List agencies that help farmers conserve soil.

I. Answers to Evaluation

1. Soil Conservation Service
2. Soil and Water Conservation District
3. Missouri Department of Conservation

4. Any three of the following:
   a) They are trained professionals.
   b) It is their job.
   c) The service is free.
   d) They can help obtain financial assistance.
   e) Each farm is different and needs individual evaluation for developing a strategy.

5. Any three of the following:
   a) Sodbuster
   b) Swampbuster
   c) Conservation Compliance
   d) Conservation Reserve

Name_____

UNIT - SOIL CONSERVATION

Date_____

Lesson 8: Agency Assistance

EVALUATION

1. A federal agency that provides technical and financial assistance to farmers for developing soil conservation systems is the _____ _____.

2. A local agency that provides technical and financial assistance to farmers for developing soil conservation systems is the _____ _____.

3. A state agency that provides farmers with conservation plant materials and technical assistance is the _____ _____.

4. Why is it important to let SCS agents help when developing a soil conservation plan?

   a.

   b.

   c.

5. What are three of the four components of the Food Security Act of 1985?

   a.

   b.

   c.